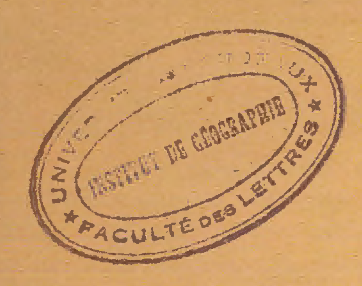


BULLETIN

DE LA

SOCIÉTÉ DE GÉOGRAPHIE D'ÉGYPTE

Tome XXXIX

1966



BULLETIN
DE LA
SOCIÉTÉ DE GÉOGRAPHIE
D'ÉGYPTE

BULLETIN

DE LA

SOCIÉTÉ DE GÉOGRAPHIE

D'ÉGYPTE

Tome XXXIX

SOMMAIRE

1966

LE CAIRE
IMPRIMERIE DE L'INSTITUT FRANÇAIS D'ARCHÉOLOGIE ORIENTALE
1968

AL-MAQRĪZI AND THE NILE FLOOD

AN ANALYTIC AND COMPARATIVE STUDY

BY

ʿABD UL-ʿAZIZ KĀMIL

I. — INTRODUCTION.

In 1966 the U.A.R. celebrated the 600 birthyear of Taqiyy-ul-Din al-Maqrīzi, the eminent Egyptian Historian. As history, in its broader concept, was his main field, it was the topic for the majority of papers dedicated to this occasion; leaving a wide room, however, for more contributions, approaching our author from other angles.

This paper tries to expound the geographical aspects of the Nile flood as treated by Maqrīzi mainly in his famous book : « Al-Khiṭaṭ » [1] with reference to his booklet « Ighathat al-Ummah » [2] where he studied the history of famines in Egypt and their relation to the Nile flood, the administrative structure, land tenure and the monetary system.

It would be appropriate on this occasion, if we could mention briefly the life of Maqrīzi [3], the countries where he lived or visited, how they

---

(1) Maqrīzi, *al-Mawaʿiz wa al-Iʿtibar bi-Zikr al-Khiṭaṭ wa al-Athār.* This paper refers to two editions : the first edited by Sheikh al-Adawi, Gov. Press, Bûlaq, 1270 A.H. = 1854 A.C.; the second is the unfinished edition of G. Wiet, Cairo, 1911 onwards. Reference is to the first if not the second is mentioned.

(2) Maqrīzi, *Ighathat al-Ummah bi-Kashf al-Ghummah,* edited and annotated by B. al-Sihai, Ibn al-Walid Press, Ḥimṣ, Syria 1956. This booklet—or essay—was first edited by Ziyada, M.M., and al-Shayyāl, G., Cairo, 1940. It is now being re-edited and re-annotated by them. This paper refers to Ḥimṣ edition.

(3) For the biography of Maqrīzi see :
(a) Sakhāwi, *al-Dawi al-Lamei,* vol. II, pp. 21-25.
(b) Ziyadah, M.M., *al-Moărikhun fi Misr fi al-Qarn al-Khamis ʿAshr A.D.,* pp. 3-25 (Arabic), 1949.
(c) Kratchkovski, *Arabskoi Geograficheskoi Literatury,* vol. II, pp. 476-487, (Arabic Version).

affected his geographical knowledge and methodology and how all of this was reflected mainly in his Khiṭaṭ.

Maqrīzi was born in Cairo in 766 A.H. = 1364 A.C. He began his studies in Islamic jurisprudence. He worked in various offices : teacher of Ḥadith (tradition) [1], judge and muḥtasib [2]. He left for Damascus, where he stayed for ten years performing the same services including conducting of wakfs [3]. Returning to Cairo ten years later, he devoted his whole life to history. He went on a pilgrimage with his family in 834 A.H. = 1430 A.C. During his stay in Higāz he gathered information — through pilgrims — about South Arabia and Abyssinia, and this information was reflected in his writings [4]. He left for Cairo in 839 A.H. = 1435 A.C. where he stayed till his death in 845 A.H. = 1442 A.C.

II. — THE GEOGRAPHICAL FACET OF AL-KHIṬAṬ.

1. The Book.

Maqrizi studied the Nile flood in the first chapter of his book : al-Khiṭaṭ. In its preface he neither mentioned the time when he started writing this book nor when he finished it. But we can presume that it took a long time and the author went on adding to it until two

[1] Sunnah or ḥadith is the second source from which the teachings of Islam are drawn. There are three kinds of Sunnah or ḥadith. It may be the saying of the Prophet which has a bearing on a religious question, an action or practice of him and his silent approval of the action or practice of another. See : Sakhawi, *Irshād al-Fuḥul Ila....'Ilm al-Isul,* p. 29, Cairo, 1349 A.D. = 1930 A.C., (Arabic), and *Encyclopedie de l'Islam,* vol. II, p. 201.

[2] Chief of municipal police. He acts as overseer of markets and morals. See *Encyclopédie de l'Islam,* vol. II, p. 337, and Hitti, Ph., *The History of Islam,* p. 322, 1937.

[3] Administer of pious foundations. By waqf (plur. awqaf) is meant a thing which while retaining its substance yeilds usufruct and of which the owner has surrendered bis power of disposal with the stipulation that the yeild is used for permitted good purposes. See Gibb and Kramers, *Shorter Encyclopedia of Islam,* p. 624, Leiden, 1953.

[4] Kratchkovski, vol. 2, p. 477.

years before his death — a period that covers about twenty years of his life [1].

The author mentions in his preface that his book falls into seven parts. But actually it is six only. Part seven is not compiled. Was it not written? This problem will be dealt with afterwards. The seven parts are :

1. Information about Egypt, its Nile, the tributes and the mountains.
2. Urbanism and ethnology.
3. The history of Fusṭaṭ and its rulers.
4. The history of Cairo, its rulers and archeology.
5. Cairo in the days of the author.
6. The Citadel of the Mountain and its rulers.
7. The causes of the decadence of Egypt [2].

2. Fact-Finding.

Maqrīzi got his information from three sources [3] :

1. reference books where by far one meets the largest part of our recorded knowledge,
2. recordings from the eminent scholars whom he met and interviewed, and
3. direct knowledge of events as an eye-witness.

He usually acknowledges the references for his data, criticizes what he rejects on a logical or an empirical basis, applying a scientific procedure, which can be found in his study of the Nile flood.

[1] Kratchkovski, vol. 2, p. 481, where he discusses the views of Guest and ʿInan. See also Ziyadah (1949), pp. 10-12.

[2] Maqrīzi, *Khitat,* Bulaq, vol. 1, p. 4 and Wiet, vol. 1, p. 10, and his footnote No. 14 on the missing part seven, loc. cit.

[3] *Khitat,* Bulaq, vol. 1, p. 4 and Wiet, vol. 1, pp. 10-11.

3. The Geographical Approach.

In his book, our author follows the traditional approach which was propounded by the majority of previous historians. Geography — in its narrower sense — was an introduction to history. The prolegomena of the book is mainly geography. He begins with a cosmographic approach showing the location of our planet in the universe, some general astronomical information : the four seasons, and the solar and lunar years... He then studies the global geography : the measurements of the globe, the distribution of land and sea... following the tradional Greek classification of the seven climata, and how the ecumene is confined to one fourth of the earth. He then expounds the limits of the climata from south to north stating briefly the physical and human characteristics of each of them. Then comes the study of Egypt, locating it in the second and third climata, describing its marine and land frontiers, the meaning of the word : Egypt and its synonyms, its merits... and probing deeply in its history. This chapter is a fine literary article. He then records the marvels of Egypt. His information here is — to a great extent — legendary, based mainly on Coptic lore. A chapter of a religious nature follows dealing with the fall of the ancient Egyptian civilisation. Then he studies the Homo Egypticus. Here, our author is severe and bitter — in spite of his deep sense of gratitude towards his birthplace « the playground of my mates, the gathering place of my folk, the nest where I grew wings» [1]. This can be the result of what Egypt had suffered during the reign of the Mamluks.

What mainly concerns us in this chapter is the ecological interpretation which our author follows trying to prove his findings on a scientific basis. He refers the human phenomena to physical elements — a methodology which shows us to what extent Maqrīzi was influenced by his professor and friend Ibn Khaldun in his famous introduction [2].

After a detailed survey in the cultural anthropology of Egypt, Maqrīzi studies the Nile [3], then turns to the tributes as a consequent subject to

[1] *Khitat,* vol. 1, p. 2.
[2] See Ziyada (1949), pp. 14-16.
[3] *Khitat,* Bulaq, vol. 1, pp. 50-72 and Wiet, vol. 1, pp. 215-304.

the flood. He then records the prominent physical and human phenomena in Egypt according to their locations. History in his study is blended with, and studied through geography to form the historical geography of Egyptian Urbanism.

Although our author follows the traditional historical procedure of beginning with a geographical introduction, his book cannot be wholly classified as pure history — or at least traditional history — for he adopts a geographical frame-work. His historical information is distributed according to geographical location not after a chronological order.

III. — THE NILE : DATA AND ARRANGEMENT.

1. The Procedure.

Our author studies the Nile as the most prominent geographical feature in Egypt. Traditionally, he begins with the merits of the Nile, different sayings about its sources and upper reaches and theories interpreting its flood. He then records the Nile gauges, its annual increase, the boat bridges that were constructed across the river between Fusṭāṭ, Rhoḍa Island and Gīza. The following chapter is a superb aesthetic composition about the pros and cons of the Nile. He then studies the marvels of the river especially the fauna and their medical benefits. Here he cites from Ibn Salīm al-Aswāni in his book « Akhbār al-Nuba» (News of Nuba). Historically, he discusses the relation between the fluctuations of the Nile flood and the rains in the south, their reflection on the welfare and misfortunes of Egypt. Then he turns to the feasts related to the annual increase of the Nile. His detailed study ends with a chapter on the irrigating canals which were fed by the Nile waters.

This treatment gives us a specimen of Maqrīzi's encyclopaedic knowledge. He blends geography with history, historical geography, zoology, literature, hydrology, medicine, folklore, and civic engineering.

Trying to classify the Nile data into defined items, the following may be suggested as main headlines :

1. Merits.

2. General description.

3. Sources.
4. General increase.
5. Constructions.
6. Pros and cons of the Nile.
7. Marvels.
8. Regime of the river.
9. Folklore.
10. Canals.

It is obvious that a logical or systematic plan could not be clearly seen running through these items from one to ten. Item one and six are literary and anthropological. Hydrology and the related subjects are scattered through items four, eight and ten. A description of the river, its tributaries and canals is found in items three, four and ten. Folklore is dealt with in item nine, which is very similar to the literary and anthropological items of one and six.

2. The Unfinished Masterpiece.

Here the question arises : was this study a draft that our author did not have the chance to re-arrange and leave us in its final shape? A step forward : might we ask whether this criticism might be levelled against the book as a whole and not only against this single study of the Nile? The answer of this question is of prime importance, for it is the yardstick with which we can view a facet of his methodology in discussing the Nile flood. The problem of the Nile flood, in this light, is not more than a sector of the book—a slice that manifests one of the main characteristics of the whole book.

This leads us to another question : has Maqrīzi written all the seven parts of the book? Part seven is completely missing. It is the part which was reserved for the study of Egypt's decadence and its cause. A problem which he had briefly dealt with in his booklet Ighāthat al-Ummah. This booklet — or essay — was written, as Maqrīzi says, in one single

night of Moḥarram 808 A.M. = 1405 A.C.[1]. Al-Khiṭaṭ ends with part six. Reading the final lines of this part one cannot help feeling that the book was finished abruptly. These final lines are brief notes about Coptic churches in Lower Egypt[2]. Even in this final chapter, some churches of Cairo[3] are noted after those of Lower Egypt —recalling that our author had already recorded the churches of Cairo[4] before those of Upper Egypt and Lower Egypt. Maqrīzi could have omitted from his preface the title of part seven, or could have written it. But neither did he omit the title nor did he write that part. Was it lost? If so, then what about the re-arrangement of the data within the six parts?

Many are the examples that can be cited to claim that al-Khiṭaṭ is not complete[5]. Having in mind that it is the best book in our Islamic legacy about Khiṭaṭ, does it remind us of the statue of the one-armed Venus, or the unfinished symphony of Beethoven? Is it a problem of a lost part or an unfinished masterpiece? One would tend to accept the second suggestion.

In this light the articles dealing with the Nile flood may be expounded and criticized. The arrangement of the data within the articles could be passed over. The study could be confined to the data recorded and the scientific method by which our author criticizes the different explanations of the Nile flood, and how he proves scientifically his point of view.

IV. — THE INTERPRETATION OF THE NILE FLOOD.

To the author, the scientific method mentioned in his preface, is based on three sources : documentary materials, interviewing of informants and his own direct observations. We can now examine to what extent this methodology was adopted while discussing the problem of the Nile flood.

---

(1) *Ighāthat al-Ummah,* p. 87.
(2) *Khitat,* vol. 2, p. 519.
(3) *Loc. cit.*
(4) *Khitat,* vol. 2, pp. 510-517.
(5) Kratchkovski, vol. 2, pp. 481-482.

Actually, in our case, these three sources can be classified into two categories, the first is the work of others, written and spoken, and the second includes his own direct observations, experiments and how he verifies his data.

1. Documentary Materials and Interviews.

Maqrīzi records two categories of interpretations : (*a*) the legendary, and (*b*) the scientific :

(a) *The Legendary Interpretations :*

These are scattered through his study as having mere historical value — as steps towards scientific thinking.

It was thought that the Nile source is in the heavens [1]. Some authors wrote that the Nile is fed by all other rivers through underground channels [2]. This is rejected by our author as ' mere imagination '. The Nile flood rises in autumn when all the waters of springs and wells run down. Older writers tried to correlate the increase of the Nile waters with the decrease of the others. Thus they suggested this fanciful interpretation [3].

(b) *The Scientific Interpretations :*

Here Maqrīzi records three interpretations that might be discussed scientifically :

I) That the annual flood of the Nile is caused by the sea tides. Actually there is an infinite variety of tide curves in different areas, due to the great number of possible combinations of the many variables [4]. Maqrīzi studied three of them : the diurnal, the fortnightly and the seasonal. The first is dominated by the semidiurnal lunar pattern, with two high waters occurring every twenty-four lunar hours, the second occurs

(1) *Khitat,* vol. 1, pp. 50-51.
(2) *Khitat,* vol. 1, pp. 50, 51 and 55.
(3) *Khitat,* vol. 1, p. 55.
(4) King, C.A.M., *Oceanography for Geographers,* p. 170; London, 1962.

twice each lunar month ; and the third twice each year. The first — of the perennial sea tides — occurs when the sun is at the end of the Virgo, and the second when it is at the end of the Pisces. If the monthly and annual tides coincide, the flood will be high. It will be higher if one — or more — of the planets is with the sun or moon [1].

II) He traces the second interpretation back to Alexander and Aristotle [2]. When they visited Egypt they observed that the width of the Nile mouth was about 100 miles. It was impossible for them to accept that the narrow upper river was the source of the big volume of high waters that the wide estuaries carried. How can they correlate the narrow upper river with the lower branches ? Alexander said — and here I quote Maqrīzi — « That the wind faces the waters [of the Nile] and prevents them from flowing and so the river inundates. He then adds another factor, « But it is impossible for the wind only to cause this, for, it can only affect the upper waters, leaving the underwaters to flow. He adds, « The wind piles the sand in the mouths of the branches that lead to the sea to form what is like a bar, and so causes the flood» [3].

Maqrīzi rejects this saying, « They investigated the influence of wind and sand but reglected the third possible factor : water ; for they did not feel the annual regime of the river which rises to its maximum for three months, and so its diurnal variations were not felt. That it why the rulers of Egypt constructed the gauge of water in Egypt» [4].

What concerns us here is that Maqrīzi rejects the two hypotheses : the effect of the tides and the effect of the wind as the main factors that cause the flood. This is expounded in two different places in the same study. Some of the arguments are repeated — another evidence for the missing final re-arrangement of the data [5].

III) Maqrīzi affirms that the Nile flood is mainly the result of the heavy rains which fall on the southern lands. The southerly rains do not fall except

(1) *Khitat,* vol. 1, p. 54.
(2) *Khitat,* vol. 1, p. 54.
(3) *Khitat,* loc. cit.
(4) *Khitat,* loc. cit.
(5) See vol. 1, pp. 54-55.

in summer. It has never happened that the Nile increased in winter [1]. He concludes, «To the question whether the flood [of water] takes place according to the hindering effect of the wind during the flood tide, I say : No. It is true that the consistency of the blowing northerly winds has its effects on the rate of increase, and the hindering effect of the sea helps in the increase. But a student of the Nile generally knows that torrents have run in it... These torrents are caused by the southerly rains. They do not fall except in summer» [2]. To sum up : Maqrīzi concludes that the main reason is the southerly rains with minor and sporadic effects of the northerly winds and the flood tide.

2. Comparison with Ancient and Medieval Scholars.

Let us now try to probe our author's data in the light of ancient and medieval legacy. Among Greek geographers, Herodotus might be the great figure that pioneered the road to comparative study of the Nile flood problem. He recorded the various explanations of the Nile annually recurring phenomenon of its inundation. Then he put forward his own interpretation after critizing and rejecting the other propounded understandings :

I) The first of these, which subsequent writers agreed in attributing it to Thales [3], the founder of the Ionian School, was that it arose from the Etesian winds, which blew from the north during the summer, and caused the water of the river to over flow by preventing it from running off into the sea. Herodotus rightly remarks the inadequacy of this explanation, inasmuch other rivers which flow in an opposite direction to these winds are not affected in the same manner, and the rising of the Nile takes place even when they do not blow [4].

(1) *Khitat,* vol. 1, p. 56.
(2) *Khitat,* loc. cit.
(3) Bunbury, *History of Ancient Geography,* vol. 1, p. 121. See also, Ball, *Egypt in Classical Geographers,* pp. 8-9.
(4) Horodotus, *The Histories,* p. 109, Penguin Classics.

Here Maqrīzi reaches the same conclusion as Herodotus but contributes, as we shall see later, some original ideas derived from practical proofs based on direct observations about the hydrography of the surface and subsurface waters, their relation to the wind and sand. It is, as a porous substance, cannot completely prevent the subsurface water from flowing [1].

While Maqrīzi relies — for intensive study — mainly on direct and continuous observations of the water regime, Herodotus relies mainly on a comparative study of more than one river. This reflects the background knowledge of the two authors : the traveller and the resident, the Greek visitor and the Egyptian native.

II) A second view which, though Herodotus does not name its author, is unquestionably that of Hecataecus Miletus [2]. Though more than half a century later in date than the preceding, it is far more primitive in its character. According to this view the increase of the volume of water was due to an assumption that the Nile is connected with the circumfluent river Oceanus, a view which may have been that of the Egyptian priests with whom he had talked. Sweetness of the Nile water was accounted for by the supposition that its saline ingredients evaporated owing to the heat of the sun in its passage through the torrid zone. Herodotus rightly dismisses this explanation without further discussion [3]. This is nowhere mentioned by Maqrīzi. We cannot be sure that he knew of this explanation or that he found it unworthy of being mentioned.

III) In Maqrīzi we do not miss the third view mentioned by Herodotus. It is assigned by Diodorus and others to Anaxagoras. According to this view, the Nile water proceeds from the melting snows during the summer on the mountains in the interior of Libya [4]. Notwithstanding the plausability of this opinion as a possible conjecture, which was later accepted by Ptolemy [5], Herodotus at once dismisses it, on the grounds,

(1) *Khitat,* vol. 1, p. 54.
(2) Tozer, *A History of Ancient Geography,* p. 63. See also Ball, p. 9.
(3) Herodotus, p. 110 and Tozer, p. 63.
(4) Herodotus, p. 110 and Tozer, 63.
(5) Ball, p. 10.

which we now know to be erroneous, that it is impossible for snow to fall on so hot a country. Maqrīzi mentions it as an opinion of mere historical value — not more than that.

iv) We miss the view of Herodotus himself which he expounds after disproving the aforesaid views : in winter time the sun moves towards the upper parts of Libya, the streams which feed the rivers there will naturally shrink during that season, in consequence of the scorching heat of its rays [1]. This suggestion might serve, as Tozer says [2], as a possible explanation of the decrease of the water in winter, but leaves untouched the question of its overflow in summer.

v) It was left for Aristotle and Eratosthenes to suggest the true cause in the tropical rains which fall during the spring and early summer on the high lands of about the upper waters of the Blue and White Niles, and this was afterwards confirmed by Agatharchides through information obtained from natives of the interior of Africa [3].

The Arab geographers, before Maqrīzi, mentioned more than one explanation of the Nile flood. Yaqūt, quoting al-Qudā'i, refers it to the ride flood and the northerly winds; and adds the southerly winds as a factor that causes its recess. He mentions these as apocryphal views and then goes on affirming that « the cause of its summer flood is that rains fall heavily on the lands of Zanzibar and those countries [where the sources exist] in these [summer] times, as if they pour out of the mouths of waterskins, torrents flow from everywhere to this river till it reaches Egypt» [4].

Although al-Baghdādi attributes the Nile flood to the southerly rains, he tries to attribute the variations of its volume — at least in part — to astrononical factors. One could collate some of his documentary materials — based mainly on Coptic lore — with what Maqrīzi has stated in his study [5].

---

(1) Herodotus, pp. 110-111.
(2) Tozer, p. 63.
(3) Tozer, p. 63.
(4) Yaqūt, *Mo'jam al-Buldān,* vol. 5, p. 335.
(5) Al-Baghdādi, *al-Ifada,* p. 61 and *al-Khitat,* vol. 1, p. 54.

To sum up : The real factor that causes the annual increase of the Nile water was verified through gathered information before Maqrīzi. At times, this accurate factor was clouded by a maze of erroneous conjectures e.g. al-Baghdādi and his astral factors.

Then, what was left for our author as an original contributor?

3. Observations and Experiments.

To expound his own view about the Nile flood, Maqrīzi does not confine himself to gathering and comparing materials and information from authentic scholars, but he records in his Khiṭaṭ some keen observations and experiments which contributes to the verification and development of his view.

i) He observes the difference in colour and suspended matters in the Nile waters. Our author says « Its waters are clear in winter and early spring. When the days of its inundation end, and its waters reach their lower mark, the taste changes and the colour becomes greenish. If some of it is put in a pot, tiny particles of fungae are sedimented». He attributes this to the flow of these waters out of the lake in the Nile upper reaches. This direct observation of suspended green fungae was previously recorded by al-Baghdādi, but he did not follow it up with subsequent observations — a procedure which was developed by Maqrīzi. When the Egyptians see this greenish water they say that « the Nile is longing» [1]. After this green wave, the water colour becomes turbid and reddish. « If you put some of it a pot — in the days of its increase — suspended clay sinks to the bottom of the pot. This clay is what is carried by the torrents that flow in the Nile and cause its increase. On it, plants are grown after the flood. Without it the lands of Egypt would be briny and cannot grow crops» [2].

Here our author relies on an experimental method to illustrate the difference between the clear, greenish and reddish waters with different suspended matters in them.

---

(1) *Khitat,* vol. 1, p. 56. «فيقال عندئذ توحم النيل»
(2) *Loc. cit.*

II) He criticizes the argument of the incapability of the narrow upper reach [at Aswan], to be the feeder of the wide north mouths on direct physical observation : «At Aswan the Nile flows in a canyon between two mountains called the cataracts, then it stretches till it flows in the sea. Its width occurs where is no [physical] obstacle that may hinder it from becoming wider» [1].

III) He also explains the relation between the volume of the flood, the irrigated area and the means of irrigation. «The lands widely differ in their altitude. Some of them are so high that they cannot be inundated except in high floods. Some are low and can be watered with a slight increase [of the flood]. In Upper Egypt digging canals is needed [because the lands are high]. In Lower Egypt constructing dikes is needed to keep the water. Farmers could control the water and store it [for irrigation] when they need with the volume they need» [2]. He then studies in details, the system of irrigation, its relation to the volume of the flood and the release of the surplus water to the sea after irrigation. This regime is fully dependent on and accomodated to the flood volume.

IV) The argument of the northerly winds as the main factor affecting the Nile flood is rejected by our author, for « this is the opinion of those who are not aquainted with Egypt. The Nile level at Aswan is higher by many statures than [its level] in Lower Egypt. If the [sea] water flows, it is hindered [by the difference of levels] from converging with the Nile waters. Sometimes the sea waters overcome the Nile waters when they are low, till the water between Dumiaṭ and Fariskūr becomes salty. I had the occasion to see the Nile mouth at Dumiaṭ and the two waters beating against each other neither side giving way to the other-each clearly distinct from the other... a lesson for those who understand» [3].

(1) *Khitat*, vol. 1, p. 56.

(2) *Loc. cit.*

(3) *Khitat*, vol. 1, p. 57. «. . . وأما فى أيام زيادة النيل فانى شاهدت مصب النيل فى البحر من دمياط وكل منهما يدافع الآخر فلا يطيقه حتى صارا متمانعين عبرة لمن اعتبر» .

V) He adds that the tidings of the Nile flood is announced from Qūṣ when it reaches sixteen cubits. This gauge is not recorded in Cairo before three days [1].

VI) When the Nile waters increase in Egypt, this increase also occurs in Nubia and the territories south of it with two main differences : (*a*) the first is that it flows in Egypt in a confined course, (*b*) the second is that its level is measured [2]. There [in Nubia], it cannot be measured for it spreads on the land. It seems that Maqrīzi here is describing the Sudd region and its swamps in southern Sudan.

These are some examples of our author's scientific method based on direct observation and practical experiments, and its application on his attempt to expound and develop his contribution to the accurate cause of the Nile flood.

V. — THE FLOOD ECOLOGY.

The hydrography of the Nile, as the main element in Egyptian life, has been the subject of study and speculation for at least six milennia. The hight of the flood has been recorded since 3600 B.C. The problem of how best to protect the waters from dissipation and wastage has involved tremendous human problems. Before the recent irrigation systems of barrages, pumps and dams, back to time immemorial, the basin system was dominant. This system permitted only one crop a year and only drought-tolerant crops such as wheat and barley [3]. It is obvious that Egypt was, as has been before the full control of its waters by the High Dam, deeply affected by the flood fluctuations — a phenomenon that has aroused great interest among scholars of Egyptian life.

This problem is one of the main interests of Maqrīzi — an interest that is reflected in many of his books. What mainly concerns us in our

(1) *Khitat*, vol. 1, p. 57.

(2) *Loc. cit.*

(3) HANCE, *The Geography of Modern Africa*, p. 120, 1965.

author's study, is that he does not credit the flood fluctuations with being the main factor dominating the Egyptian life. He does not underestimate their influence and the overwhelming damages that may be inflicted by heavenly forces [1]. In his study of famines in the Arab World, he states clearly that they may be the result of heavenly factors like low floods of the Nile, absence of rains in Syria, Iraq and Hejaz, hot storms that destroy the crops, or by swarms of locusts that eat them [2].

But Maqrīzi affirms that what happens in Egypt is largely due to human factors. When the administrative structure is solid and the ruler has a firm hand on it in critical times, the low flood could be overcome. Several illustrative examples of efficient rulers are given. He concludes in his essay «Ighāthat al-Ummah», that what happens is Egypt is due to three main factors which have no fourth [3] :

1. Securing governmental jobs through bribery :

Ignorant, unjust and atrocious officials could attain public offices if they could make contact with the court of the Sultan. The whole burden of corruption falls at last on those who are living at the bottom of the social structure, especially land tillers. They were actually compelled under the tyranny of unjust rules to evacuate their lands. Those who stayed were overloaded by taxes. The major part of the public finance was spent by the rulers on their pleasures, without real concern for what would maintain the common standard of living, or at least, would lessen its collapse.

2. Increasing the prices of arable lands :

Some of the attendants of the emirs strive to become nearer and nearer of those who gather the power in their hands. Money is the best means to get nearer to them. Land tillers are forced by those official

---

(1) Maqrizi, *al-Seluk,* edited and annotated by Ziyadah, vol. 1, part 1, see for exemple his analytic study for the flood of 597 A.H. = 1200 A.C., pp. 154-158.

(2) Maqrizi, *Ighathat,* p. 41.

(3) *Op. cit.,* pp. 43-47.

opportunists to pay what they had been ordered. This was reflected on the final prices of the crops. Many villages deteriorated and nearly or completely were evacuated, with shortage of crops due to the death of many tillers, decrease of agricultural manpower and death of their animals. The economic structure was falling down and the vicious circle of cruelty, death, and high prices went on.

3. Inflated currency and its effect on the prices of goods :

The governments short changed the people by getting the genuine gold and silver currency out of their hands in return for actually counterfeited money.

These are the three main causes of famines in Egypt as deducted by Maqrīzi. The problem could be solved by taking measures to stabilize the prices by healthy administrative control and putting the right man in the right place. Depleted currency should be abolished, gold and silver currency should be the standard to which all prices would be contributed.

This study illustrates that Maqrīzi, in dealing with the flood ecology, does not accept a passive stand on the part of man versus nature. He confirms the initiative, responsibility, and mobility of man, operating within a frame of natural forces, to avoid catastrophies, and overcome them when they happen. It may be concluded that Maqrīzi is an early pioneer of « possibilism», a philosophy that places greater emphasis on the human effort than allowed for by the «determinists».

CONCLUSION

1. It seems fair to assume that the data concerning the Nile flood have not been methodically arranged. The Khiṭaṭ as a book suffers from this defect. This leads to suggest that al-Khiṭaṭ as we have it now, was but a draft which the author, for one reason or the other, did not put in its final shape.

2. In studying the Nile flood, the author expounded some of the many and varying interpretations which can be traced back to the Greek

and Arab authors. He chose the right view and developed it through out his study :

(a) He did not fail to consult the eminent scholars whom he read or met without losing sight of his discriminative procedure both in his acceptance and rejection.

(b) He had the unique advantage of writing about the Nile from direct observation of its course from Aswan to the sea.

(c) He also performed practical experiments on its waters : their colour, taste and suspended matters in them.

3. Finally, he did not miss the relationship between the fluctuations of the Nile flood and the tempo of life in Egypt and its vicissitudes of prosperity, decline and stability. In his ecological methodology, Maqrīzi gives the Homo Egypticus an active role in shaping his life with a possibilistic attitude that puts responsibility on man and his strife for a better life.

REFERENCES

Al-Baghdadi, A., *Al-ifadah wa al-Iʿtibar fi al-Imur al-Mushada wa al-Hawadith al-Muʿayana bi-ard Misr.* Cairo (N.D.)

الافادة والاعتبار فى الأمور المشاهدة والحوادث المعاينة بأرض مصر لعبد اللطيف البغدادى ط المجلة الجديدة القاهرة (بدون تاريخ) .

Ball, J. *Egypt in Classical Geographers.* Gov. Press, Cairo 1942.

Bunbury, (Sir E.H.). *History of Ancient Geography.* London 1883.

Encyclopédie de l'Islam. Leyden and Paris 1913.

Gibb, H.A.R. and Kramers, J.H. *Shorter Encyclopaedia of Islam.* Leiden 1953.

Hance, W.A. *The Geography of Modern Africa.* Columbia Univ. Press, New York 1965.

Herodotus. *The Histories.* Translated by Aubrey de Sélincourt. *The Penguin Classics,* Reprinted 1963.

Maqrizi. *Al-Mawaʿiz wa al-Iʿtibar bi-zikr al-Khitat wa al-Athar.* Bulaq 1270 A.H.

كتاب المواعظ والاعتبار بذكر الخطط والآثار للمقريزى .

—— *Kitab al-Selūk li-Maʿrifat Dowal al-Melūk.* Edited and annotated by M.M. Ziyadah. Cairo 1934 onwards.

كتاب السلوك لمعرفة دول الملوك .

—— *Ighathat al-Ummah bi-Kashf al-Ghummah.* Edited and annotated by Badr-el-Din Al-Sibaii, Syria 1956.

اغاثة الأمة بكشف الغمة .

King, C.A.M. *Oceanography for Geographers.* London, Edward Arnold 1962.

Kratchkovski (I.U.). *Istoria Arabskoi Geograficheskoi Literatury.* Moskova-Leningrad 1957. Arabic version by Hashim, S.O., Cairo 1963.

Sakhawi. *Al-Dawi al-Lamei li-Ahl al-Qarn al-Tāsei.* Cairo 1353 A.H.

الضوء اللامع لأهل القرن التاسع للسخاوى .

Tozer, H.F. *A History of Ancient Geography.* Cambridge Univ. Press, 1897.

Yaqūt. *Moʿjam al-Buldan.* Beirut 1955.

معجم البلـدان لياقوت .

Ziyadah, M.M. *Al-Moârikhun fi Misr fi al-qarn el-Khamis ʿAshr A.D.,* Cairo 1949.

المؤرخون فى مصر فى القرن الخامس عشر الميلادى (القرن التاسع الهجرى) لزيادة .

SOILS OF THE GAZA STRIP

BY

M. A. ABDEL SALAM AND S. A. SABET

SUMMARY

Gaza area (326 sq. km.) is an elongate strip extending about 46 km. along the Mediterranean with width varying from 7 km. in the north to 12 km. in the south near Rafah. The main towns from north to south are; Beit Hanoun, Beit Lahia, Gabalia, Gaza, Deir El-Balah, Khan Yunis and Rafah.

Climate is of a Mediterranean type with conditions changing from semi-arid in the north to arid in the south.

The landscape is characterized by the occurrence of elongate ridges and elongate depressions. The main ridges from east to west are; Beit Hanoun-Abassan, El Muntar, Deir El-Balah and the coastal ridges. The depressions East El Muntar and East Gaza are filled with a deep loamy clay formation where most of the citrus plantations are located. In the south it gives way to another formation of lighter texture where grain crops are raised under dry farming. In the West Gaza depression drift sand is deposited over the loamy clay soil. The Near-Shore depressions are occupied by sand dunes and sand accumulations, most of which are under afforestation.

The soils were studied and classified into the following groups: the coarse textured Kurkar soils, the coastal dune sands, the El-Mawasy soils, the loamy clay alluvial soils and the loess-like soils. Description of the representative profiles were given and the analysis of the soils and irrigation water were reported.

From the agricultural point of view, Kurkar soils are under afforestation since 1928. They are gradually changing into irrigation agriculture with the increasing number of deep wells. Sand dunes are under different cultivation systems depending upon the depth of sand. With the increasing depth the system changes from citrus cultivation into the cultivation of fruits other than citrus then afforestation. In the depressions filled with loamy clay soil most of the citrus plantations are located. The loess-like soils produce the grain crops under dry farming.

Loamy clay soils are regarded as class one. The patches covered with sand are class two and the eroded parts are class three. The irrigated

Kurkar soils are grouped under class four while loess-like soils are temporarily regarded as class five. With the availability of irrigation water their position will change. Sand dunes are class six soils.

The number and discharge of wells decrease from north to south. The quality of water deteriorates in the same direction. Calculations of water consumptive use requirements showed that water is applied in adequate amounts in the north. South of Gaza additional amounts of water have to be added to satisfy both plant needs and leaching requirements.

I. — INTRODUCTION.

Gaza area (326 sq. km.) is an elongate strip bounded on the north and east by the Armistice line, on the south by the U.A.R. Sinai Border and on the west by the Mediterranean coast.

The strip extends about 46 kms. along the Mediterranean with width varying, from 7 kms. in the north to 12 kms. in the south near Rafa. The main towns from north to south are; Beit Hanoun, Beit Lahia, Gabalia, Gaza, Deir El-Balah, Khan Yunis and Rafah (Fig. 1). The area is accessible from El-Arish by a rail-road and a 95 kms. asphalt road.

The strip which is under the U.A.R. Government directorate is occupied by the Palestinian Refugees. Population intensity is high and living conditions are unfavourable.

To improve the situation both Governmental and International Organizations planned to expand the cultivated area. Outside the strip boundaries the United Nations Relief and Works Agency and the U.A.R. Government agreed to develop about 50,000 feddans east of the Suez canal for the refugees benefit. Within the boundaries of the strip, the plans were made to drill more wells and increase the cultivated area.

Research required was organized by the Desert Institute and accordingly several visits were paid starting December 1958.

The geology, geomorphology, hydrology and soils of the area were studied. This paper deals with the soils aspect.

Previous information on the soils of the strip is briefly given by Reifenberg (1948), Ravikovitch (1953), Ravikovitch and Dan (1957) and Koyundjisky (1963) while dealing with the soils of Palestine.

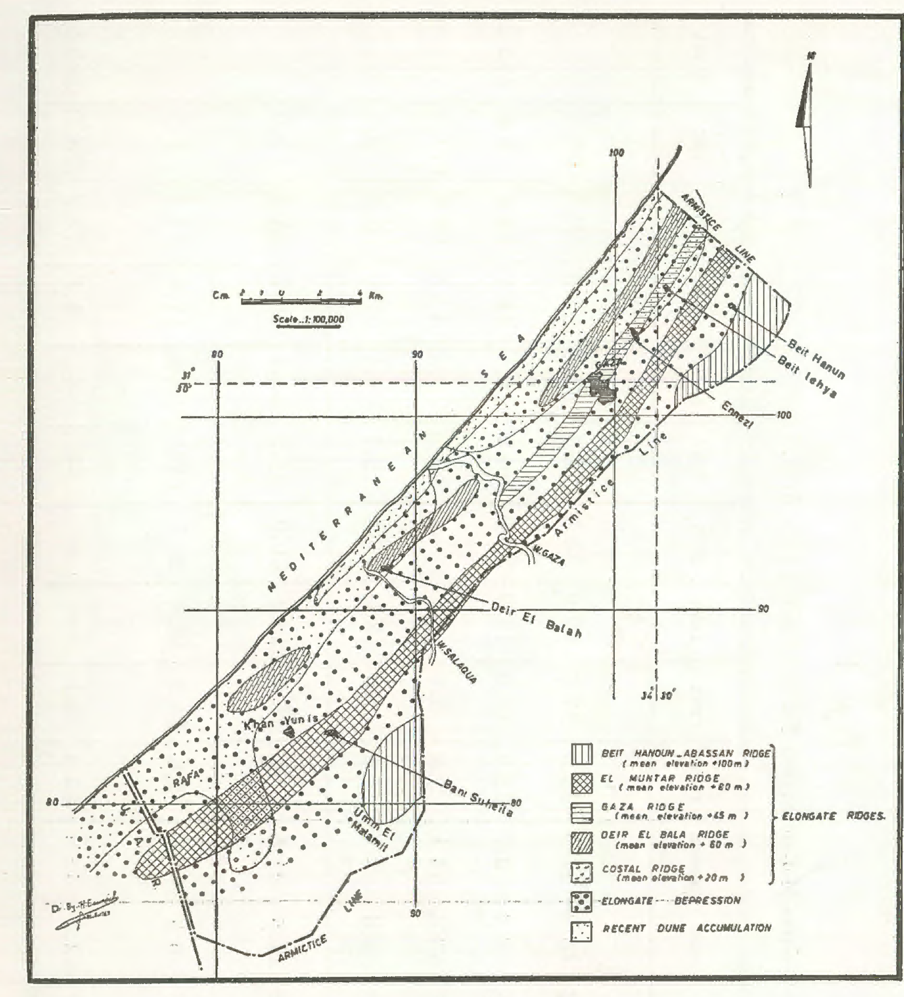


Fig. 1.
Physiographic Map of Gaza Area.

II. — CLIMATE.

Mean monthly records of temperature, rainfall and wind velocity in Gaza and Rafah are given in table 1. The table indicates similar annual temperature variations all over the strip. The records of Rafah in the south are only very slightly higher than those of Gaza town in the north. The maximum temperature is recorded in August while January bears the lowest.

TABLE 1

Some Meteorological Features of the Gaza Area.

MONTHS OF THE YEAR METEOROLOGICAL	LOCATION	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
Features :	Gaza													
Temp. { Mean Max. C°		18.2	18.6	21.3	24.0	27.3	29.0	30.0	30.7	29.8	28.0	25.1	20.3	
Temp. { Mean Min. C°		7.8	8.0	9.7	11.9	15.0	17.9	20.0	20.6	19.4	16.8	13.6	9.6	
Rainfall : m.m. (1940-1953)		81.1	53.6	53.1	5.8	4.6	—	—	—	1.5	15.9	68.5	111.6	395.7
Wind velocity : (Km/hr.)		4.0	4.0	3.3	3.3	3.0	3.0	3.0	2.7	2.4	3.0	3.7	3.7	
Temp. { Mean Max. C°	Rafah	20.2	21.8	21.5	23.9	26.7	29.2	30.9	31.5	30.4	28.7	24.4	19.9	
Temp. { Mean Min. C°		7.8	9.5	9.6	12.6	14.9	18.4	20.5	21.2	19.0	17.6	13.2	9.3	
Rainfall : m.m. (1951-1956)		29.4	42.0	32.9	13.5	0.1	—	—	—	—	1.1	78.3	98.2	295.5

Rainfall records indicates a somewhat different trend. Apparently rain increases in the northern direction; a difference of about 100 mm. of rainfall between Gaza and Rafah is detectable.

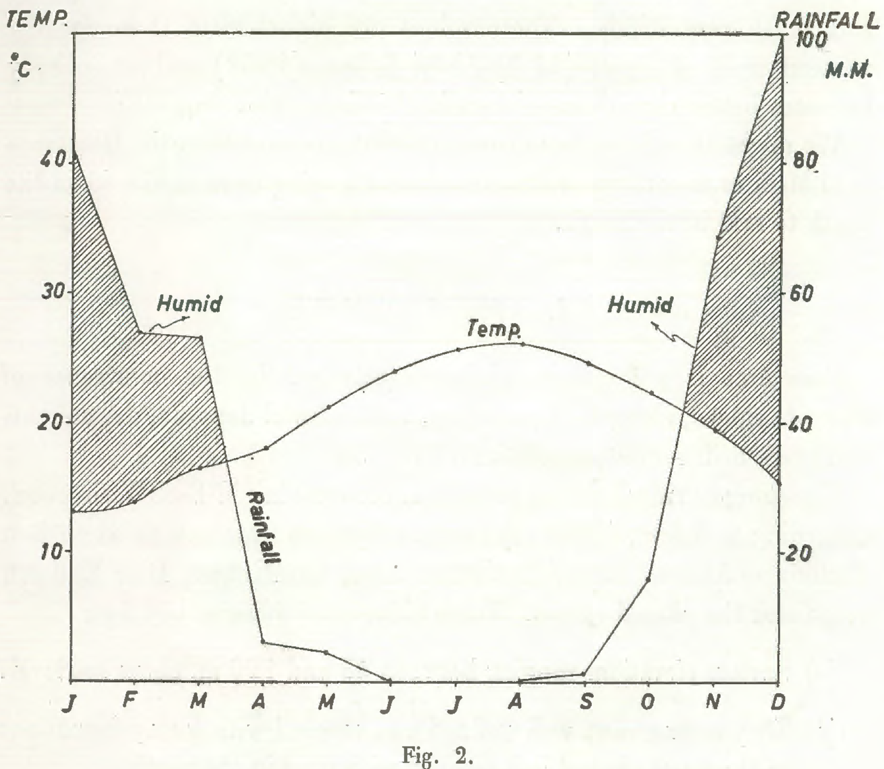


Fig. 2.
Xerothermic Diagram of the Gaza Area.

The table also reveals the presence of two different climatic seasons alternating with one another, in that two of the summer months are nearly and four are completely devoid of rain.

Application of Lang's rain factor to the data given in table 1 in the way suggested by Reifenberg (1948) gives a value of 17.5 for Gaza and 12.9 for Rafah. These values indicate the prevalence of semi-arid conditions in Gaza changing into arid towards Rafah.

The Xerothermic diagram for the Gaza town constructed according to Walters' method (1950) is given in Fig. 2. It shows at a glance that dryness prevails over most of the year in this locality.

Embergers' degree of aridity (Migahid et al, 1953) is another index introduced to suit the Mediterranean climate. The values obtained by dividing annual rainfall by the square of the difference between maximum and minimum mean temperature records are 91.3 and 75.0 for Gaza and Rafah respectively. These values are higher than those for the western coast of Egypt (22.0) Abdel Salam, (1962) and accordingly indicates better climatic conditions in the Gaza strip.

We might then be able to conclude that the climate in the Gaza area is of Mediterranean type with conditions changing from semi-arid in the north to arid in the south.

III. — PHYSIOGRAPHY.

Gaza area is a foreshore plain characterized by the occurrence of elongate ridges, elongate depressions, thick alluvial deposits, dry streams and great drift sand accumulations.

The elongate ridges extend parallel to the coast in a NNE-SSW direction. According to Salem, (1963) the main ridges are from east to west; Beit Hanoun — Abassan ridge, El-Muntar ridge, Gaza ridges, Deir El-Balah ridge and the coastal ridges. These ridges are characterized by :

(*a*) Surface elevations ranging between 45 and 120 m. above sea level.

(*b*) They are narrow, well defined and covered with loamy formations in the north, broad and covered with sand in the south.

(*c*) The substratum is the calcareous sandstone formation.

The alternating depressions are from east to west; east El-Muntar depression, east Gaza depression, west Gaza depression and the Near-Shore depression. The first two depressions are covered with a loamy clay soil formation of considerable depth. This formation is the dominant in the north at Beit Lahia, Gabalia, east of Gaza and El Buraig, where most of the citrus plantations are located. In the south at Deir El Balah, Khan Yunis and to the east of Rafah it gives way to another formation, sandy in texture where wheat and barley are cultivated under natural precipitation.

The third depression is covered with sand which has apparently deposited over the older clayey formation and is developed into low undulating dunes. The near-shore depression is covered with drift sand accumulations.

The narrow coastal plain, between the wave-break line and the coastal ridge, is covered with beach sand which is intermixed in places with shell fragments.

The modern sand accumulations form a coastal belt ranging in width between 2-3 kms. in the north to 7 kms. in the south near Rafah. They are essentially composed of Quartz grains.

The major dry stream is Wadi Gaza which traverses the area in an E-W direction. It is filled with worn — out gravels and is bordered on both sides by alluvial terraces.

IV. — GEOLOGY.

The surface of the Gaza area is covered by Quaternary deposits, Pleistocene and Holocene.

According to Salem (1963), the Pleistocene deposits are represented by two main formations :

1. Continental alluvial and aeolian deposits known as « Continental Kurkar Complex».

2. Near-shore deposits known as marine Kurkar.

The Holocene deposits form :

(*a*) the modern sand accumulations,

(*b*) the top soil layers both alluvial and aeolian (sand),

(*c*) the gravels filling the wadi and dry streams, and

(*d*) the shell fragments intermixed with beach sand and known locally as « Zufzuf».

V. — CLASSIFICATION OF SOILS.

As previously mentioned, the landscape in the Gaza area is a series of elongate ridges which run parallel to the coast and alternate with elongate depressions. The substratum of the ridges is, almost without exception, composed of the calcareous sandstone formation known as the « Continental Kurkar Complex».

The ridges are covered with loamy clay soil in the north and sandy soil in the south. Exceptional is the coastal ridge which is covered witb sand all through the area.

The elongate depressions are filled with alluvial and aeolian deposits. East El Muntar and east Gaza depressions are filled with alluvial heavy textured soils while west Gaza and the Near-Shore depression are filled with aeolian sands.

In the south the sands give way to a fine sandy formation, described as of loess-like type, El Gabaly (1954) Ravikovitch (1953) and Salem (1963).

Thus, it becomes obvious that the soil formations are closely associated with the physiographic features. The main soil groups being :

1. The coarse textured Kurkar soils.
2. The coastal dune sands.
3. The El-Mawasy soils.
4. The alluvial soils.
5. The loess-like soils.

In the following a brief description of each group is given.

1. The Kurkar Soils.

The Continental Kurkar Complex which forms the substratum of the elongate ridges is exposed to the surface in the northern part of the coastal ridge. Examination of the exposed beds west of Gaza town (Pl. I, A) revealed the great degree of the consolidation of the rocks. This is explained as due to the upwards and downward movements of

water containing calcium and silica in solution, Reifenberg (1948) and Salem (1963).

The weathered surface, possibly mixed with drift sand forms Kurkar soils. This group dominates the area from Gabalia Forest to the northern Armistice Line (Map No. 1). It has been under afforestation by Acacia, Tamaris and Eucalyptus since 1927.

Field examination showed that the typical profile consists of 10 cm. of sand in which the roots of the growing vegetation are distributed (Pl. I, B). From 10 to 50 cm. the soil matrix is a mixture of coarse sand and calcareous sandstone concretions of 0.5-1 cm. diameter. In this layer the lateral roots of the growing trees are found. Below this depth the concretions increase in size and abundance to 50 percent by volume of the soil mass.

Chemical analysis (fusion) of the calcareous sandstone and the formed Kurkar soil is given in table 2.

Table 2

Chemical Analysis of Calcareous Sandstone and Resultant Kurkar Soil

COMPONENT	CALCAREOUS SANDSTONE %	KURKAR SOIL %
SiO_2	60.5	6.48
Al_2O_3	0.5	10.54
FeO_3	0.9	3.24
CaO	3.8	2.10
MgO	0.5	2.10
K_2O	tr.	0.36
Na_2O	tr.	0.92
P_2O_5	tr.	0.21
CO_2	13.2	2.41
H_2O	0.3	0.30

The formed soil contains less calcium carbonate and more of the oxides of the other components. Apparently the weathering of the

calcareous sandstone beds was accompanied by the dissolution of lime (cementing material) through hydrolysis.

Analysis of the 1 : 5 soil water extract and mechanical analysis is given in table 3. From the table it could be observed that soil reaction is alkaline, calcium carbonate is present in moderate concentrations (5-7%) and salt content in low (0.13%). Organic carbon content though generally low, throughout the soil profile yet, it is comparatively higher in the top 10 cm. due to vegetative growth and higher root density.

Mechanical analysis was undertaken after separating the concretionary portion which constitutes from 11 to 50 per cent of the soil volume. The data given in table 3 show that most of the particles in the top 50 cm. are in the coarse sand fraction. Below this depth fine sand increases appreciably and silt + clay only slightly.

Kurkar soils are under afforestation since 1927. Recently parts were changed into citrus plantations under permanent irrigation. The Project «Amers' Project» started in 1960 with 9 deep wells irrigating 2500 donums i.e. approximately 600 feddans.

As the tree roots cannot enter the consolidated Kurkar beds, the soil would then be unsuitable for citrus culture if the beds were found at a slight depth from the surface. In this area, there is sufficient depth of weathered soil. This factor, together with the out standing efforts of the local cultivators, citrus cultivation becomes possible.

2. The Coastal Dune Sands.

Sand dune accumulations cover most of the coastal area. They are particularly noticeable in the south, from El-Someiry to Rafah, where they approach 7 kms. in width. In the northern and central parts they are developed into non-continuous, irregularly oriented dune ridges. The sand grains consist primarily of quartz.

The origin of these dunes was discussed by several geologists. The theories refer to the possibility of the local weathering of the upper Miocene sandstone strata, Moon and Sadek (1921) or to the deposition of Nile sediments, Shukri and Philip (1959), Salem (1963) showed

Table 3

Salt Composition, Soil Reaction, Lime and Carbon Contents, and Mechanical Composition of Kurkar Soils

(Percentages)

SOIL DEPTH CM.	pH ON PASTE	$CaCO_3$ %	TOTAL C %	T.S.S. %	ANIONS			CATIONS			MECHANICAL COMPOSITION (1) %		
					HCO_3	Cl	SO_4	Ca	Mg	Na	COARSE SAND	FINE SAND	SILT CLAY
0- 10	7.82	5.11	0.15	0.12	0.04	0.01	0.05	0.01	tr.	tr.	93.6	0.2	1.1
10- 30	8.23	4.91	0.06	0.11	0.04	0.01	0.04	0.01	tr.	0.01	94.3	0.1	0.7
30- 55	8.15	6.70	0.08	0.15	0.05	0.02	0.06	0.01	0.04	0.01	88.9	3.3	1.1
55-120	8.15	7.50	0.01	0.16	0.05	0.01	0.06	0.01	0.01	0.02	47.0	42.0	3.5

(1) Particles above 2 mm. diameter are screened and weighed separately.

by heavy mineral analysis a strong similarity between the minerals of Gaza and North Sinai dunes. It is then likely that the dune sands originating from the Sinai desert has accumulated along the coast by coastal sea-drift.

The analysis given by Salem (1963) for the heavy mineral fraction shows that 25% of which is in the form of opaque minerals (mainly iron oxides). Disregarding this part, pyroxenes, hornblend, and epidote are present in the concentrations of 36, 26, and 18 percent respectively. Garnet, zircon, glauconite and staurolite are present in much smaller concentrations, 4, 2.5, 3.5 and 1.5 percent respectively. All the dunes from Gaza to Rafah proved to have the same heavy mineral composition.

Sand dunes progress steadily and encroach on fertile land. The picture taken west of Beit Hanoun (Pl. II, A) explains the status.

Dune sands overly heavy textured alluvial deposits or fossil soils. Where sand is present in a shallow layer, ideal conditions for plantations are created. As the depth of sand increases dry farming agriculture then afforestation must be applied.

Chemical Composition.

The chemical composition of dune sands is given in table 4. Apparently, they contain more silica and less calcium than the soils derived from calcareous sandstone (Kurkar). They contain hardly any organic matter and practically no nitrogen.

TABLE 4

The Chemical Composition of dune sands
(Percentage)

pH	$CaCO_3$	CARBON	Si_1O_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	NaO	P_2O_5	CO_2	H_2O
8.18	6.7	0.06	82.0	10.59	0.13	1.48	1.85	0.29	0.82	0.21	1.14	0.27

They are poor in phosphorous but contain higher than average quantities of potassium. They have a moderately alkaline reaction and lime content ranging between 2 and 7 percent.

Mechanical Composition.

The sandy soils are texturally uniform throughout their profile (Table 5). The sand content is very high and the grains are mostly in the coarse sand fraction.

The shallow group of sandy soils, represented by profile 28, exhibit a clay loam subsoil below 90 cm. from the surface. This is explained by penetration of the sands into the territory of heavy textured alluvial soils.

Salinity of Sandy Soils.

The soluble salt content of the dune sands is low (Table 5); less than 0.15 percent. This is possibly due to the comparatively higher rainfall rates both in the north and by the coast.

Land Use.

Dune sands are divided into four depth groups namely; 0-0.5, 0.5-1.5, 1.5-5, and above 5 m. from the surface to substratum. The first depth is favourable for citrus cultivation, the second is suitable for fruit trees other than citrus, the third is for special fruits under dry farming and the fourth is for afforestation.

For afforestation, Eucalyptus, Tamarisk and Acacia are the common types. Apparently, they find enough soil water to survive even in the driest and hottest season of the year.

3. EL-MAWASY.

El-Mawasy (sing. Masia) is a common name that stands for the low-lying, levelled patches of land scattered between the coastal undulating dune sands.

Most of them are man-made. The local cultivators exert great efforts in removing the surface layers of dry sand down to the moist clay sand beds. There, the plant seedlings are left to grow happily without any need for supplemental irrigation.

TABLE 5

Salt Composition, Soil Reaction, Lime and Carbon Contents and Mechanicals Composition of dune sands (Percentages).

LOCATION	DEPTH CM.	$CaCO_3$ %	TOTAL CARBON %	pH ON PASTE	T.S.S. %	ANIONS %			CATIONS %			MECHANICAL COMP. %		
						HCO_3	*Cl*	SO_4	*Ca*	*Mg*	*Na*	COARSE SAND	FINE SAND	SILT + CLAY
Gabalia (El-Hawaber)	0-15	3.62	0.04	8.06	0.107	0.045	0.012	0.030	0.012	0.005	0.003	89.6	4.3	2.4
	15-40	2.92	0.06	8.13	0.097	0.023	0.007	0.046	0.006	0.006	0.009	94.2	2.8	0.1
	40-150	1.47	0.06	7.93	0.084	0.032	0.009	0.014	0.008	0.006	0.005	95.7	0.3	2.5
Beit Lahia (El-Sayafa)	0-15	6.70	0.01	8.25	0.098	0.040	0.007	0.032	0.011	0.004	0.004	88.7	4.3	0.3
	15-75	7.33	0.09	8.35	0.087	0.044	0.009	0.016	0.012	0.003	0.003	74.5	6.4	11.7
	75-120	6.00	0.17	8.25	0.107	0.045	0.009	0.034	0.010	0.005	0.004	84.8	4.7	4.5
Beit Lahia (El-Sayafa)	0-5	3.26	0.09	7.35	0.083	0.032	0.007	0.026	0.010	0.005	0.003	87.6	8.3	0.9
	5-90	3.24	0.09	8.45	0.086	0.035	0.007	0.024	0.010	0.005	0.005	87.3	7.1	2.4
	90-150	10.60	0.20	8.18	0.119	0.053	0.008	0.030	0.018	0.006	0.004	21.5	21.9	46.1

This type of agriculture is practiced all over the coast from Gabalia Forest in the north to Rafah in the south. The soils vary in texture with the dominance of the coarse sandy type.

Not with standing textural variations the soils have certain common features which are :

1. The presence of 5-10 cm. of surface dry sand.
2. Below this surface moisture is present in amounts increasing gradually with depth. This moisture is within the available range for the growing plants.
3. The main water table is present at depths not exceeding 1.5 m. from the surface.

Analysis of a representative profile is given in table 6. The main characteristics being ; low total salinity, mildly alkaline soil reaction and very low organic carbon content.

Mechanical analysis reveals the presence of two distinct layers of different textures and $Ca\ CO_3$ contents. The upper layer of 65 cm. depth is sandy with coarse grains, while the $Ca\ CO_3$, content is low. The lower layer, down to 140 cm. from the surface is loam to clay loam with much higher concentrations of lime. At this point another sandy layer fully saturated with water is located. The soil profile is moist all through the whole depth.

Land Use.

El-Mawasy are cultivated with vegetables and fruit trees ; citrus, guava, apples, pears and vines depending upon the soil available moisture.

4. ALLUVIAL SOILS.

Alluvial soils, dominated by heavy textured loamy clay, are developed in the northern depressions and slopes stretching from the Armistice Line in the north to the present course of Wadi Gaza. The depth of which is generally considerable, borings to the east of El-Muntar ridge reported about 25 m. of alluvial deposits, Salem (1963). Another phase is recognized in the present course of Wadi Gaza and the

Table 6

Salt Composition, Soil Reaction, Lime and Carbon Contents and Mechanical Composition of El-Mawasy Soils (Percentages).

Soil depth	pH	$CaCO_3$	Total C	T.S.S.	Anions			Cations			Mechanical analysis		
cm.				%	HCO_3	*Cl*	SO_4	*Ca*	*Mg*	*Na*	Coarse sand	Fine sand	Silt + clay
0-65	8.0	4.8	0.11	0.105	0.029	0.010	0.046	0.009	0.002	0.009	85.3	1.6	8.3
65-140	7.9	6.8	0.12	0.128	0.042	0.019	0.044	0.013	0.003	0.007	40.4	2.8	40.1

other drainagse lines where the soils are composed of a heterogenous mixture of sands and gravels.

The properties of the heavy textured alluvial soils are similar to those of the Calcic-Brown group of soils characteristic of the semi-arid climatic zone. Yet, soil properties do not only reflect climatic conditions as they receive additional moisture through irrigation.

The soil profile is characterized by reddish brown colour, loamy clay texture, and a developed structure. At about 50 cm. from the surface a conspicuous layer of lime accumulation is located (Pl. III, A), the depth of which ranges between 50-80 cm.

In the following a description of a representative profile is given.

Profile No. 3.

Location : Beit Hanoun.

Horizon	Depth (cm.)	Description
Ap	0- 20	Gray brown (10 YR 5/3) granular, sandy clay loam to silt clay loam; friable. Consistency hard when dry, soft when moist and sticky when wet.
A_3	20- 30	Greyish brown (10 YR 5/4) clay loam; medium to fine (moderate) subangular blocky structure contains some very fine lime spots.
B_1	30- 45	Transitional horizon. Brown (10 YR 4/9) silty clay having of medium, moderate, subangular blocky structure, Consistency very hard when dry, firm when moist and plastic on wetting. Presence of clay skin is slightly indicated. Bigger concretions of lime are noticed more frequent.
B_2	45- 70	Strong brown (10 YR 3/3) loamy clay; strong to moderate, subangular blacky breaking to small blocks and weak prisms. Clay skin is present more frequent and cover the surface of the peds. Soft lime concretions are characteristics of the horizon.
B_3	70-120	Reddish Brown (5 YR 4/3) loamy clay having a strong subangular blocky structure which breaks into small blocks and prisms. Lime concretions almost disappear; clay skin is more distinct.

Along the slopes and on top of the adjacent elongate ridges the B_2ca horizon is exposed to the surface. It is underlain by a shallow B_2 overlying the main Kurkar beds. The surface horizons have apparently been removed by rain water to be deposited in the depressions below. This relation is schematically illustrated in Fig. 3.

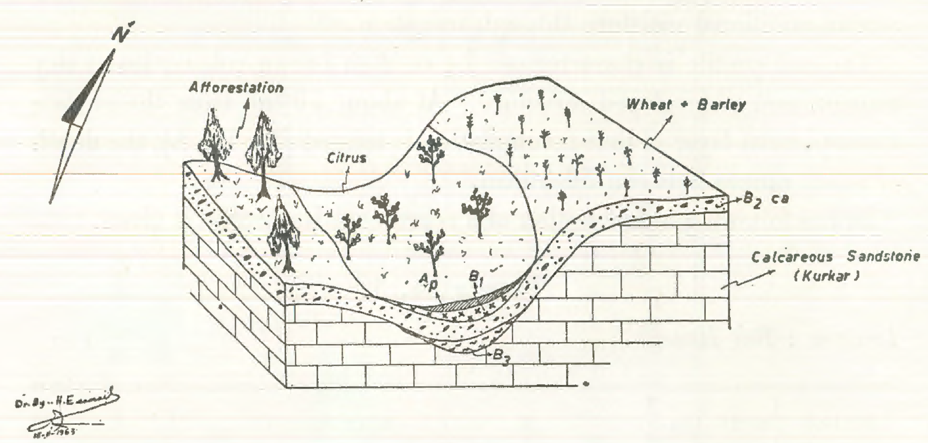


Fig. 3.
Block Diagram Showing the Effect of Topography on Soil Depth and Profile Horizons.

Chemical Composition.

Chemical Composition of typical alluvial soil is given in table 7. Apparently, the soils contain less silica and more $CaCO_3$ than any of the previously described soils. Phosphorus and potassium are present in moderate concentrations, *p*H values (Table 8) indicate a moderately alkaline reaction. Organic carbon content decreases with depth; the comparatively higher concentration in the upper layers is the resultant of cultivation and management.

TABLE 7

Chemical Composition of Alluvial Soils (Percentages).

DEPTH OF SOIL	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	K_2O	Na_2O	P_2O_5	CO_2	H_2O
50-80	46.0	9.2	13.1	6.3	8.1	0.7	0.7	0.5	9.1	6.1
110-115	56.0	7.1	11.2	3.6	5.9	1.1	1.1	0.5	6.3	7.2

TABLE 8

Soil Composition, Soil Reaction, Carbon and Lime Contents and Mechanical Composition of Heavy Textured Alluvial Soils.

(Percentages)

DEPTH OF SOIL CM.	*p*H ON PASTE	$CaCO_3$	TOTAL C	T.S.S.	ANIONS			CATIONS			TEXTURE	MECHANICAL COMPOSITION			
					HCO_3	Cl	SO_4	Ca	Mg	Na		COARSE SAND	FINE SAND	SILT	CLAY
0- 10	7.65	16.1	0.42	0.28	0.04	tr.	0.20	0.01	tr.	0.03	Sandy Clay loam	17.2	35.1	22.0	27.0
10- 30	7.65	16.0	0.39	0.16	0.04	0.04	0.05	0.01	tr.	0.02	Clay	10.5	31.2	1.5	59.4
30- 55	7.75	20.2	0.26	0.17	0.05	0.03	0.16	0.01	tr.	0.02	»	11.3	31.6	19.7	44.8
65- 80	7.95	20.7	0.21	0.25	0.06	0.03	0.15	0.01	tr.	0.01	»	8.9	24.3	10.0	54.8
80-110	8.15	10.5	0.21	0.13	0.05	0.03	0.02	0.01	tr.	0.01	»	13.2	23.8	24.8	43.5

Mechanical Composition.

According to their mechanical composition, alluvial soils belong to the loamy clay class (Table 8). The texture is uniform throughout the depth of profile with the exception of the upper 10 cm. This surface layer is enriched with sand, mostly fine sand, and thus exhibits a lighter texture.

Salinity Conditions.

The soluble salt content is low to moderate (Table 8). The relative increase of salts in the surface layer is probably due to the application of deep well water containing variable amounts of salts, for irrigation.

Land Use.

The heavy textured alluvial soils are almost fully occupied with well developed citrus plantations (Pl. III, B 3). Oranges, var. Shamouti, and grape-fruit are the dominent types, they also form the principal exports for Gaza strip.

This method of utilization does not necessarily mean that the soils are most suitable for citrus cultivation. Actually the good management of the local cultivator together with the regular additions of sand ameliorates the soil physical conditions and provide suitable beds for the growing trees.

5. Loess-Like Soils.

Loess and loess-like soils occupy quite a considerable area in Palestine. Their origin is disputable and several theories are given by pedologists. The aquatic theory attributes the transportation of dust from which the soils are developed to water action, the aeolian theory to wind action, and a third theory attribute the origin to weathering in situ of various parent materials.

Ravikovitch (1953) discussed this problem and reviewed the various views concerning the origin of loess and loess-like soils in Palestine. Most acceptable of them is the aeolian-aquatic deposition theory.

Loess and loess-like soils exhibit different textures. The latter is lighter, looser and almost forms a transition type between loess and sandy soils.

In the Gaza area the loess-like type of soils is predominant. It occupies an area extending from Deir El-Balah to Rafah, and mostly located on the eastern side of the main road. The soils can be divided into two main textural groups :

(1) Loess-like soils with profile of sandy clay loam to sandy loam texture, (2) Loess-like soils with profile of loamy sand.

1. Loess-Like Sandy Clay Loam Soil.

This group covers an area extending from Wadi Gaza in the north to Khan Yunis in the south. Southward the soil texture changes from sandy clay loam to sandy loam. Within the depth of profile there is no apparent change in texture with the exception of the surface ploughed layer. There, the entrapped drift sand is mixed with the surface through management operations and thus a lighter textured surface soil is developed.

Another characteristic feature is the presence of a conspicuous layer of lime accumulations at 50-90 cm. below the surface. Lime accumulates in the form of soft concretions and very fine mycelium like threads.

A typical profile is described as follows :

SOIL HORIZON	DEPTH CM.	DESCRIPTION
Ap	0-10	Brownish yellow (10 YR 6/6) sandy loam quite worked with fine roots. Structure; weak subangular blocky intermixed with single grained fine sand. The top 2 cm. forms a disturbed crust of weak platy structure.
B_1	10-38	Brownish yellow (10 YR 6/6) sandy clay loam, little compact in site but friable in hand. Structure is not definite and porosity is low to medium.

SOIL HORIZON	DEPTH CM.	DESCRIPTION
B_2 *ca*	38-110	Brownish yellow (10 YR 6/4) sandy clay loam. Structure is moderate, medium, blocky and subangular blocky. The blocks contain numerous pin-point pores root channel, channels of fauna filled with exercements; they are friable and easily crumbles in smaller aggregates. Lime soft concretions are scattered in a mosaic-like form.
B_3	110-140	Slightly harvier texture, possibly silt clay loam, having a brownish yellow colour; slightly developed structure; and few soft lime concretions.
C	140 +	Yellowish brown loam to silt loam; compact in site; massive.

Chemical and Mechanical Composition.

As shown by table 9, the soils contain medium quantities of phosphorous and potassium. The silica content is somewhat higher than that for the loamy clay alluvial soil. The profile is homogenous with respect to other components yet, the amounts of iron and aluminum vary little with depth.

TABLE 9

Chemical Analysis of loess-like sandy clay loamy soils (Percentages).

SOIL DEPTH CM.	$Si\,O_2$	$Fe_2\,O_3$	$Al_2\,O_3$	$Ca\,O$	$Mg\,O$	$K_2\,O$	$Na_2\,O$	$P_2\,O_5$	CO_2	$H_2\,O$
15-60	78.00	2.63	5.20	3.30	1.80	0.36	0.60	0.15	5.90	1.03
60-90	71.00	4.54	2.01	6.30	4.10	0.60	0.24	0.16	8.62	2.39
90-150	72.00	5.61	3.51	3.60	5.20	0.60	0.22	0.20	5.24	3.34
550-180	70.01	5.89	3.30	3.90	5.60	0.72	0.19	0.20	6.96	3.30

The data given in table 10 indicate that soil reaction is moderately alkaline while *p*H ranges between 7.9 and 8.5. Organic carbon content is generally low throughout the depth of profile yet, it is slightly higher

TABLE 10

Soil Reaction, Salt Composition, Lime and Carbon Contents and Mechanical Composition of Sandy Clay Loam, Loess-Like Soils.

(Percentages)

SOIL DEPTH CM.	*p*H ON PASTE	$Ca\,CO_3$	TOTAL C	T.S.S.	ANIONS			CATIONS			TEXTURE	MECHANICAL COMPOSITION			
					HCO_3	*Cl*	SO_4	*Ca*	*Mg*	*Na*		COARSE SAND	FINE SAND	SILT	CLAY
0- 40	7.95	8.0	0.20	0.14	0.04	0.01	0.05	0.01	tr.	0.01	Sandy Clay loam	25.9	38.4	10.4	25.5
40- 90	8.55	12.0	0.12	0.21	0.06	0.01	0.02	0.01	tr.	0.02	loam	26.7	30.0	13.3	23.9
90-120	8.53	6.9	0.11	0.13	0.05	0.01	0.04	0.01	tr.	0.02	»	43.3	28.5	17.3	28.3

in the top layers as a result of cropping and management. Percent $CaCO_3$ increases in the 40-90 cm. layer where lime obviously accumulates in the form of soft concretions.

The total salt concentration is low and practically similar values are obtained for the entire depth of profile.

Mechanical composition changes slightly with depth and indicates that the texture is sandy clay loam throughout.

Land Use.

With the exception of very few wells that supply the newly developed citrus orchards with irrigation water, dry farming is the principal practice. Fruits, other than citrus, are cultivated in the depressions wherever subsoil moisture exists. However, most of the area is cultivated with wheat and barley under natural precipitation.

2. Loess-Like Loamy Sandy Soil.

This group occupies the area from Khan Yunis to Rafah. It is characterized by a deep uniform profile; with soil particles coherent in site but friable and loose in hand. Lime accumulates in a conspicuous layer of variable depth and thickness in the form of soft concretions and mycelium-like threads.

The following is a description of the representative profile.

HORIZON	DEPTH CM.	DESCRIPTION
Ap	0-10	Very pale brown (10 YR 7/4) very fine sand, slightly worked with fine roots into weak, medium, subangular blocks. It has a general massive appearance. It is slightly hard when dry, slightly sticky when wet.
B_2	10-42	Very pale brown (10 YR 7/3) fine sand to loamy sand. It has a very weak subangular blocky structure and contains few $Ca\ CO_3$ concretions. Consistency is friable when dry slightly sticky when wet.

HORIZON	DEPTH CM.	DESCRIPTION
$B_2\ ca$	90	Very pale brown (10 YR 7/3) loamy sand. It has a weak subangular blocky structure and contains numerous lime concretions of various hardness and size. Consistency is friable when dry and slightly sticky to slightly plastic on wetting.
B_3	90-107+	Very pale brown (10 YR 7/4) loamy sand; weak subangular blocky; contains very few lime concretions.
C	107+	Pale brown loamy sand; having a massive appearance; compact and cherent in site but friable in hand; slightly plastic on wetting; contains few lime concretions.

Chemical and Mechanical Composition.

The loamy sandy soils contain relatively higher silica and slightly lower phosphorus and potassium than the sandy clay loams (Table 11).

The amount of oxides of iron and aluminum are also slightly lower than those for the heavier textured soils.

Soil reaction is moderately alkaline. Carbon content is low and the values decrease with depth. Lime content is higher in the 10-35 cm. layer where it obviously accumulates (Table 12).

TABLE 11

Chemical Analysis of loess-like loamy sandy soils (Percentages).

SOIL DEPTH CM.	$Si\ O_2$	$Fe\ O_3$	$Al_2\ O_3$	$Ca\ O$	$Mg\ O$	$K_2\ O$	$Na_2\ O$	$P_2\ O_5$	CO_2	$H_2\ O$
0-50	83.0	2.41	2.20	5.10	0.53	0.36	0.24	0.11	3.70	2.29
50-120	82.0	2.20	3.22	4.80	2.20	0.48	0.19	0.11	2.51	2.05

TABLE 12

Analysis of Profile I in Rafa representing the Loamy Sandy Loess-Like Soils.

(Percentages)

DEPTH OF SOIL CM.	pH ON PASTE	$CaCO_3$	TOTAL C	T.S.S.	ANIONS			CATIONS			TEXTURE	MECHANICAL COMPOSITION			
					HCO_3	*Cl*	SO_4	*Ca*	*Mg*	*Na*		COARSE SAND	FINE SAND	SILT	CLAY
0- 10	7.35	5.54	0.30	0.18	0.05	0.01	0.06	0.01	tr.	0.01	Loamy Sand	27.7	59.2	2.0	12.5
10- 35	7.90	12.17	0.12	0.18	0.06	0.02	0.05	0.02	tr.	0.02	»	24.0	60.8	1.0	18.5
35- 70	7.90	9.33	0.03	0.18	0.05	0.02	0.05	0.03	0.02	0.02	»	22.0	60.8	0.4	14.0
70-150	7.85	7.20	0.09	0.18	0.05	0.02	0.03	0.02	0.01	0.01	»	30.3	50.9	5.7	13.1

Table 12 also shows that mechanical composition belongs to the loamy sand class. Moreover, the soil is texturally uniform throughout the entire depth of profile.

Land Use.

The area occupied by loess-like loamy sands is under dry farming agriculture depending principally upon the scanty winter rainfall. Barley is the main crop, it is cultivated in October or November and normally harvested by the end of March or beginning of April.

Recently, few test wells were drilled for hydrogeological investigations. The water collected which proved to be of moderate to bad irrigation qualities, is used for irrigating the newly developed fruit orchards.

VI. — SOILS AND AGRICULTURE.

The economic importance of citrus culture for Gaza Strip, oranges and grapefruit, are the principal exports, is responsible for the given to citrus cultivation. Wherever irrigation water becomes available, citrus cultivation replaces the other agricultural systems.

At present, the main center of citrus culture is situated in the depressions filled with thick alluvial loamy clay deposits north of Wadi Gaza. South of Wadi Gaza, citrus is cultivated where new wells are drilled and water is pumped out for irrigation. Coastal dunes and sand dune accumulations are under afforestation while the Kurkar soils that have been under afforestation since thirty years are gradually changing into irrigation agriculture with citrus as the predominant crop. The loess-like soils extending from Deir El-Balah to Rafah are utilized for raising wheat and barley crops, and tobacco in limited areas, under the natural winter rainfall. The condition is illustrated in Figs. 4 and 5.

The intensity of citrus cultivation thus decreases from north to south. Apparently this condition is the outcome of the natural decrease in rainfall, and well water discharge as well as the deterioration in the quality of irrigation water, in the same direction.

The 1958 agricultural census (Table 13) indicates that practically all of the citrus cultivation is concentrated in the Gaza area. Since then more wells have been drilled and additional areas around and south of Gaza were planted with citrus trees.

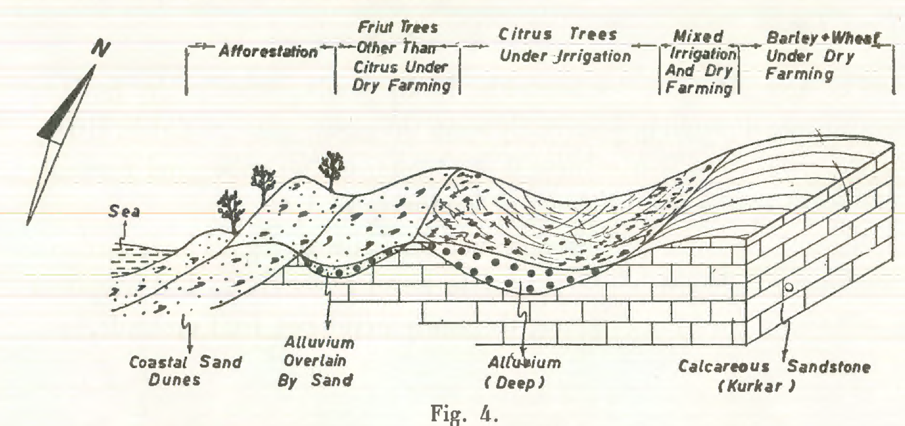


Fig. 4.
Block Diagram Illustrating the Relation Between Physiography and Land Use North of Wadi Gaza.

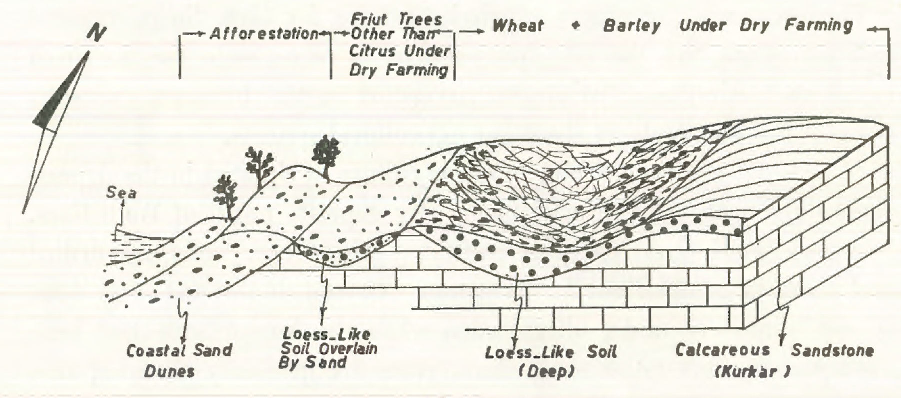


Fig. 5.
Block Diagram Illustrating the Relation Between Physiography and Land Use South of Wadi Gaza.

Land Classification

In classifying the land of the Gaza Strip it was found convenient to use a system based primarily upon the Land Capability Classification of the Bureau of Reclamation (1953) but modified to fit the local

conditions. The soils are thus divided into 6 groups. The first 3 groups refer to irrigated soils. Group 4 includes soils which are changing into irrigation agriculture. Group 5 includes soils under dry farming but adaptable to irrigation farming whenever water becomes available. Group 6 represent non-arable lands which cannot be brought under cultivation.

Table 13

Area in donums under the different cropping systems in the Gaza Strip according to the 1958 Census.

	AREA IN DONUMS [1]				
LOCATION	CITRUS	FRUITS OTHER THAN CITRUS	DRY FARMING	NOT CULTIVATED	TOTAL
Gaza	10848	20435	72129	52039	151851
Deir El-Balah......	461	4490	17213	4741	26905
Khan Yunis	48	7286	28979	45034	81347
Rafah	100	811	29511	36231	66649

[1] donum = 1000 m. i.e. approx. 0.25 feddan.

The land groups are briefly described as follows :

Class I.

Lands belonging to this class are ideal for irrigation farming with no limitations or continuing hazards. The soil is deep and is able to store and supply moisture to plants. Relief is level to gently sloping.

The alluvial loamy clay soil occupied by citrus plantations represent this land class. The soils physical conditions might not be typical of class one yet, the amelioration of which is possible and is undertaken by the local cultivators.

Class II.

This class comprises soils which are moderately suitable for irrigation farming. Their productivity is lower than that of class one due to certain deviations.

In the Gaza Strip Class two comprises the sandy areas in which sand overlies the loamy clay soil in depths not exceeding 1 m. The presence of sand will undoubtedly decrease the amount of soil available moisture and increase water losses.

Class III.

This is fairly good land with more limitations or continuing hazards. Belonging to this class is the loamy clay alluvial soil, eroded phase, located along the slopes of the elongate ridges. The deficiencies in this case are : (1) the moderate to steep slope, (2) the moderate to shallow depth of soil and (3) the possible presence of indurated hardpans.

Class IV.

This is marginal land for agricultural purposes. Under very careful management, it will produce fair to poor yields of few crops.

Kurkar soils which are changing from afforestation into citrus cultivation are included under this land class. The Kurkar soil profile is coarse textured, open, and holds very little available water for the growing plants. Amelioration of such soil together with good and careful management is obviously essential.

Class V.

Normally, class 5 comprises lands of undetermined value which are non productive because of lack of engineering works that would provide adequate drainage and flood control. Loess-like soils are grouped under this land class not because of inherent deficiencies but due to the lack of irrigation water. At present they are cultivated with grain crops under natural precipitation but with water availability their position would then be corrected.

Four sub-classes are recognized according with variations in texture and slope, they are :

(*a*) Sandy clay loam, gently sloping land.

(*b*) Sandy clay loam, steeply sloping land.

(*c*) Loamy sand, gently sloping land.

(*d*) Loamy sand, steeply sloping land.

Class VI.

Class 6 refers to areas covered by sand dunes where the suitability for irrigation farming is questionable.

In the Gaza Strip the depth of sand to the loamy clay substratum determines the suitability of soil for utilization. Accordingly, two sub-classes are distinguished :

(*a*) Coastal dunes ranging in depth between 2 and 5 m. They are under afforestation or dry farming depending upon the distance from the coast and consequently the depth at which the subsurface moisture is located.

(*b*) Coastal dunes exceeding 5 m. in depth. Only parts of which are under afforestation.

The distribution of land classes and sub-classes over the strip is shown in Map 2.

Irrigation Methods, Water Quality and Water Requirements

As previously stated, both dry and irrigation farming techniques are practiced in the area. Dry farming depends upon the natural precipitation and subsurface water. Sizeable areas, particularly those located in the south of Wadi Gaza, are cultivated with barley and wheat under winter rainfall. Also, in the depressions between the coastal dunes, vegetables, vines, apples and several other fruits are cultivated in the moist layer of sand and raised depending upon the subsurface water supply.

Irrigation agriculture depends upon deep well water. Water is pumped out by water pumps and then given to the citrus trees which are located at 5 m. spacings at the rate of 60-70 m^3 per irrigation per donum (donum = 1000 m^2). The trees are irrigated every 5-8 days in summer and 15 to 20 days in winter.

Furrow irrigation is the method used and no sprinkler irrigation is practiced.

Water quality — In appraising the quality of irrigation water, consideration is given to the total salinity and salt composition. The diagnostic methods of the U.S. Salinity Laboratories, Richards (1953), depends on the expressions :

(*a*) electrical conductivity (E C), (*b*) Sodium adsorption ratio (S A R) and (*c*) residual sodium carbonate (R S C).

Electrical conductivity, with a standard unit milli mhos/cm, is used for indicating the total concentration of ionized constituents i.e. the total dissolved solids. The sodium adsorption ratio is a calculated value and is defined by the equation $SAR = Na^{+}/\sqrt{Ca^{++} + Mg^{++}/2}$ in which the concentrations are expressed in meq/L.

The exchangeable sodium percentage (E S P) which the soil will eventually attain when it and water are in equilibrium can be predicted from S A R of the water. The term residual sodium carbonate is difined as :

$$RSC = (CO_3 + HCO_3) - (Ca^{++} + Mg^{++}).$$

Analysis of representative well water samples is given in table 14. The calculated S A R, E S P and R S C values are shown in columns 13, 14, and 15 respectively. The data indicate an increase in salinity from north to south. The wells located north of Gaza town contain medium salinity waters that could be used for irrigation if moderate leaching occurs. Calculated S A R and R S C and the predicted E S P values do not provide indications of sodium or alkali hazards.

South of Gaza town well waters contain appreciable amounts of salts that prohibit their use for irrigation unless (*a*) drainage is adequate, (*b*) salt tolerant crops are cultivated and (*c*) additional quantities of water are applied for salt leaching. S A R and E S P values indicate moderate to high sodium effects while most samples are free of any residual sodium carbonate.

The application of high sodium waters for irrigation requires special management as sodium tends to be fixed or adsorbed by soil in an exchange form. Reclamation involves the replacement of exchangeable sodium

TABLE 14

Chemical Analysis of some representative well water samples.

WELL NO.	LOCATION	ANIONS (MEQ./1).						CATIONS (MEQ./1.)				SAR	ESP	RSC
		EC_e	P.P.M.	CO_3	HCO_3	*Cl*	SO_4	*Ca*	*Mg*	*Na*	K			
54	Beit Hanoun........	0.87	510	tr.	5.46	3.26	0.69	2.0	2.20	4.86	0.32	3.27	3.0	1.26
137	Beit Lahia..........	0.30	197	tr.	3.14	0.59	tr.	2.0	1.27	0.58	0.12	0.34	0.3	—
72	Gabalia	0.97	604	1.20	1.18	4.37	3.50	4.60	2.34	3.05	0.15	1.64	1.8	—
180	Gaza town..........	0.37	236	tr.	2.63	0.98	0.16	1.48	1.45	0.80	0.15	0.66	0.7	—
260	Wadi Gaza	3.80	1920	0.47	4.88	19.03	6.03	3.0	4.60	17.39	0.90	8.92	11.0	—
308	East of Wadi Gaza ..	2.90	1856	0.64	4.58	19.74	3.46	3.79	4.21	21.74	0.92	10.87	13.0	—
233	West of Wadi Gaza...	5.40	3520	tr.	4.88	42.44	12.81	5.65	9.93	40.0	1.24	14.32	16.0	—
318	East of Deir el-Balah. .	3.25	2080	1.12	3.79	26.72	3.75	3.0	3.39	30.22	0.50	16.90	19.0	—
294	W. of Deir el-Balah...	2.35	1527	1.04	5.08	12.97	2.60	1.40	2.79	15.43	0.88	10.65	13.0	1.93
219	Deir el-Balah C. dunes	3.60	2304	tr.	5.70	23.42	6.30	5.40	8.79	22.30	nil.	8.37	10.0	—
400	B. Seheila	6.80	4352	nil	5.0	54.99	21.76	6.39	7.91	66.08	1.25	9.50	11.0	—
402	Khan Yunis	5.40	3456	nil	6.80	33.84	18.33	3.50	6.10	47.83	1.05	21.83	24.0	—
419	Rafah	3.40	2176	nil	3.68	19.43	—	7.30	7.60	18.43	1.07	6.75	8.0	—

by calcium and the removal of sodium by leaching. The addition of calcium, preferably in the form of gypsum, to the water or to the soil is the recommended practice for correction of such effects.

Irrigation Water Requirements.

The volume or quantity of water required for irrigation depends upon many factors which include : the kind of crop to be grown, the climatic conditions during the growing period and the efficiency of the irrigation system and irrigator. In the Gaza area citrus orchards are under a permanent system of irrigation. They receive one to two irrigations during the winter season (Dec. to March), 2-3 irrigations during April, October and November, four irrigations during May and September and 8-10 irrigations during summer the months (July to August). Irrigation water is applied at the rate of 65 m^3 per donum per irrigation.

The amount of water that is used directly by the plants plus that which is evaporated from soil form the water consumptive use requirements.

The observed consumptive use rates (irrigation water applied multiplied by irrigation efficiency 75 % + rainfall) in inches of depth for each month are given in tables 15 and 16 for Gaza and Rafah respectively. According to the method of Blaney and Criddle for the determination of consumptive use, Roe (1950, p. 175), the monthly percentages of daytime hours (p) for Gaza (latitude 34° N) and Rafah (latidude 31° N) were obtained and given in the same table. The mean monthly temperature values in degrees Fahrenhirt (t) are also included. The monthly consumptive use factors (f) are obtained by multiplying $p \times t$ and are given in column 14.

For the Gaza area the sum of the monthly consumptive use values amounts to 40.5 inches. If the value of 0.6 is used as the empirical crop coefficient for citrus and is multiplied by the sum of the monthly consumptive use factors which is 68.35, the product then gives the calculated seasonal consumptive use in inches which is 41.11.

Obviously this calculated values is very much similar to that obtained from actual observations.

For the Rafah area, the sum of the monthly consumptive use values (37.8") is appreciably lower than the calculated value (41.4"). Moreover,

the water used for irrigation in the Rafah area is saline and additional quantities of water should be added to satisfy the leaching requirements.

TABLE 15

Observed Consumptive Use of water for Gaza

MONTH	PERCENTAGE OF DAY TIME HOURS (LAT. 34 N.) (P)	MEAN MONTHLY TEMP. ° F (T)	P X T	OBSERVED CONSUMPTIVE USE IN INCHES		
				APPLIED IRRIGATION WATER	RAINFALL	TOTAL
January	7.10	55.4	3.93	0.62	3.24	3.86
February	6.92	55.9	3.87	0.62	2.16	2.78
March	8.35	60.0	5.01	0.62	2.17	2.79
April	8.80	64.2	5.65	1.14	2.12	3.26
May	9.72	70.2	5.82	2.48	0.24	2.72
June	9.70	74.1	7.19	4.46	0.20	5.16
July	9.88	78.0	7.71	4.46	—	4.46
August	9.33	78.4	7.31	4.46	—	4.46
September	8.35	76.6	6.40	2.48	—	2.48
October	7.90	72.3	5.71	1.14	0.08	1.22
November	7.02	66.7	4.68	1.14	0.64	1.78
December	6.93	58.8	4.07	0.62	2.67	3.29

TABLE 16

Observed Consumptive Use of water for Rafah

MONTH	PERCENTAGE OF DAY TIME HOURS (LAT. 34 N.) (P)	MEAN MONTHLY TEMP. ° F (T)	P X T	OBSERVED CONSUMPTIVE USE IN INCHES		
				APPLIED IRRIGATION WATER	RAINFALL	TOTAL
January	7.25	57.20	4.15	0.62	1.17	1.79
February	7.0	60.26	4.22	0.62	1.68	2.30
March	8.37	60.08	5.03	0.62	1.31	1.93
April	8.73	65.60	5.73	1.14	0.54	1.68
May	9.58	69.44	6.65	2.48	—	2.48
June	9.55	74.84	7.15	4.96	—	4.96
July	9.72	78.26	7.61	4.96	—	4.96
August	9.25	79.52	7.36	4.96	—	4.96
September	8.34	76.46	6.38	2.48	—	2.48
October	7.96	73.76	5.87	1.14	0.44	1.58
November	7.15	65.84	4.71	1.14	3.13	4.27
December	7.10	58.20	4.13	0.62	3.92	4.54

It could be then concluded that the present irrigation regime is satisfactory for the Gaza area. South of Gaza the water applied do not satisfy neither the consumptive use requirements nor the leaching requirements.

REFERENCES

ABDEL SALAM, M.A. (1962). Soils of the Maryut Agricultural Project. *The Desert Institute Bulletin* (under Publication).

BUREAU OF RECLAMATION STAFF (1953). Irrigated land use and land classification, vol. V, part II. Bureau of Reclamation Manual, U.S. Dept. of the Interior.

DAN, J. and KOYUMDJISKY, H. (1963). The soils of Israel and their distribution. *The J. of soil science,* vol. 14, No. 1, pp. 13-20.

EL-GABALY, M.M. (1954). The soil, water supply, and agriculture in North Eastern Sinai. *The Desert Institute Bull.*, vol. Tome IV, No. 1, pp. 125-153.

MIGAHID, A.M., and ABDEL RAHMAN, A.A. (1953). Studies in Water economy of Egyptian Desert plants. *The Desert Institute Bull.,* vol. III, No. 1, pp. 5-24.

MOON, F.W. and SADEK, H. (1921). Topography and Geology of North Sinai. *Petroleum Research Service.* Egypt, Ministry of Finance, Cairo, Bull. No. 10.

RAVIKOVITCH, S. (1953). The Aeolian Soils of the Northern Negev, Proceedings of the International Symposiums on « Desert Research » Sponsored by UNESCO.

RAVIKOVITCH, S. and DAN J. (1957). Soils of the Central and Southern Negev. Ford Foundation Research Projects, pp. 211-228. *Israel Foundation Trustees,* Jerusalem.

REIFENBERG, A. (1948). The soils of Palestine. Thomas Murley and Co. London.

ROE, H.B. (1950). Moisture Requirements in Agriculture. 1st Edit. Mc Graw — Hill Books Co. N.Y.

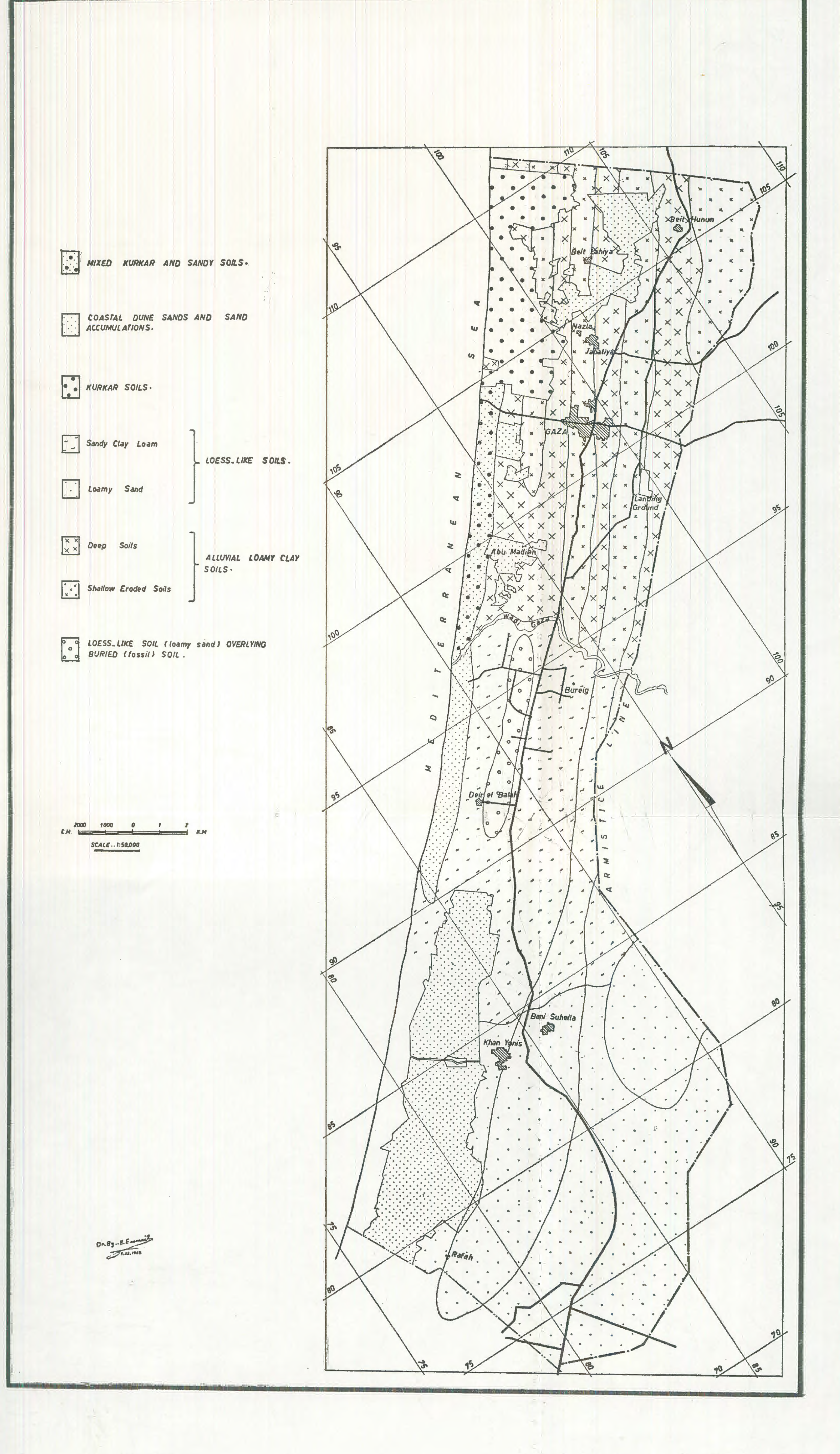
SALEM, R. (1963). Geology and Ground Water Supplies between Gaza and El-Arish town. *M. Sc. Thesis,* Faculty of Science, Cairo University.

SHUKRI, N. and PHILIP, G. (1959). The Mineralogy of Some Recent Deposits in the Arish-Gaza Area. *Bull. of the Faculty of Science,* No. 35, Cairo University.

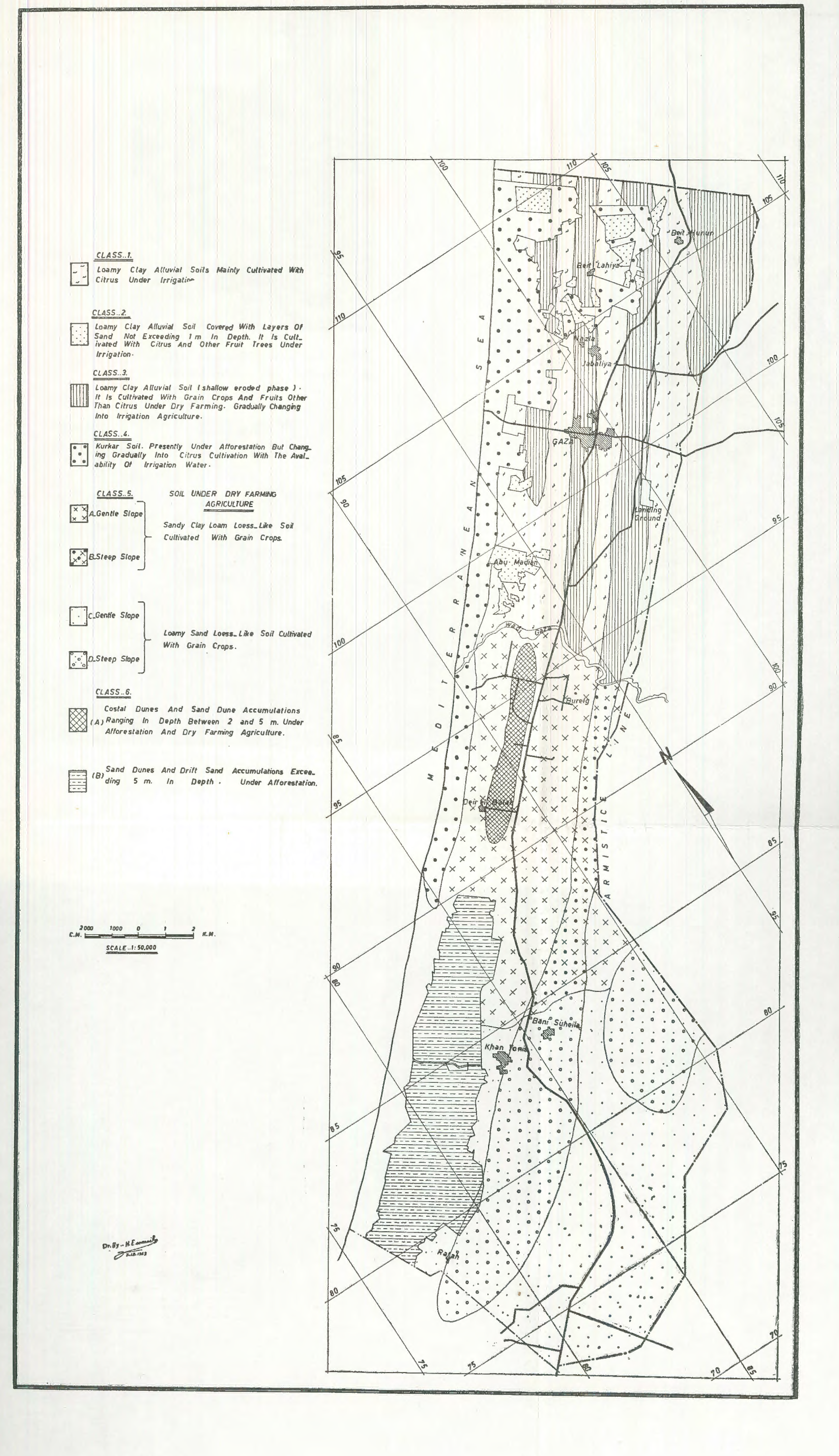
WALTER, H. (1955). Die Klimmagrammcals Mittel Zum Beusteilung Der Klimaverheltmisse Und Landwirts chaft. Liche Zwerche.

MAP 1

SOIL MAP OF THE GAZA STRIP



MAP 2
CLASSIFICATION OF THE SOILS IN THE GAZA STRIP FOR LAND USE





A. — The exposed Kurkar beds of the coastal ridge. The distance to the wavebreak line is 8-12 m.



B. — Kurkar soil profile in Gabalia Forest. Note the pronounced coherence and the scattered calcareous sandstone concretions.



A. — Sand dunes encroaching upon loamy clay fertile land.



B. — Showing the considerable thickness
of the loamy clay alluvial deposits.



A. — Deep loamy clay profile in Beit Hanoun. Note the accumulation of lime in a conspicuous zone.



B. — A citrus grove in Beit Lahia on sloping land. In the background, the afforested coastal dune ridge is shown. View looking north-west.



A. — A dune ridge which has been lately afforested with Acacia sp.



B. — Dense plant growth on a dune ridge in Gabalia Forest. Afforestation of this area began in the 1928.



An apple orchard under dry farming agriculture. The trees satisfy their water needs from the subsurface moisture.

THE CLIMATE OF THE SUDAN
ACCORDING
TO THREE CLIMATIC CLASSIFICATIONS

BY

Dr. YOUSSEF A. M. FAYED

INTRODUCTION

This study compares the performance of three climatic classifications in the Sudan. Koppen (1936), Thornthwaite (1948-1955), and Bailey (1958-1960) [1]. Climatic summaries published by the Meteorological Department of the Sudan were analyzed for all the stations included in the Sudan. Maps were prepared for the comparable elements of the classifications. The patterns of the classifications were then compared with each others, with the maps of rainfall, temperature and vegetation distributions.

LOCATION AND TERRAIN

Sudan covers a large area of 967,500 square miles. It extends between latitudes 3° oo N, and 23° oo N, and between longitudes 21° oo E and 39° oo E, thus the country lies within the tropics. However, the great expanse of the Sudan along 20° of latitude and over 18° of longitude

---

(1) Koppen, W., and R. Geiger, *Handbuch der Klimatologie,* Band II, Berlin, 1936.

Bailey, Harry P., A Simple Moisture Index Based upon a Primary Law of Evaporation, *Geografiska Annaler,* Hafte 3-4 (1958), pp. 196-215.

——, A Method of Determining the Warmth and Temperateness of Climate, *Geog. Annaler,* Nr. 1 (1960), pp. 1-16.

Thornthwaite, C.W., An Approach toward a Rational Classification of Climate, *Geographical Review,* vol. 38 (1948), pp. 55-94.

gives rise to a wide variety of climatic conditions. The longitudinal expansion is effective in relation to the oceanic influences from the west and the east; or in other words from the Atlantic and the Indian Oceans.

The Sudan in general has a monotonous surface, only about 2% of the area of the country lies over 1,000 feet above sea level. This type of terrain has its climatic consequences. Very small parts of the country are high enough to be climatically different from their surroundings [1].

The high mountains of the Sudan are like inselbergs, isolated in different parts of the country and without continuity (Fig. 1). Their influences are limited to their locations and immediate surroundings; and they do not stand as climatic barriers.

The Imatong Mountains lie east of the line Juba-Nimule and south of the line Juba-Kapoeta, they are very close to the border between Sudan and Uganda [2]. The highest parts of the Imatongs rise to 11,000 feet above sea level.

The Red Sea Hills in the eastern part of the Sudan extend about 15 to 20 miles from the shore inland and they run almost parallel to the coast. These hills constitute the western horst of the Eastern African Rift Valley. The altitude here ranges between 3,000 and 4,000 feet.

The Marra Mountains in Darfur Province in western Sudan extend over 125 miles long and between 20 and 25 miles wide. They are a group of volcanic cones, the peaks of which rise to about 10,000 feet above sea level.

The Nuba Mountains in Kordofan Province in western Sudan are a group of isolated hills mounted over a high plain, the local relief is about 3,000 feet above the plain which is 2,000 feet above sea level.

One of the topographic features that affect the local climate of the southern part of the Sudan is the existence of a vast swampy area between latitudes 5° N and 10° N, resulting from the blocking of the (Sudds) in the course of the Nile, and the overspilling of its waters.

---

(1) Y.P.R., Bhalotra, *Meteorology of Sudan,* Sudan Meteo. Service, Memoir No. 6. Printed by P and T Department, 1963.

(2) H.M. Barbour, *The Republic of the Sudan,* Univ. of London Press Ltd. London, 1961, pp. 26-37.

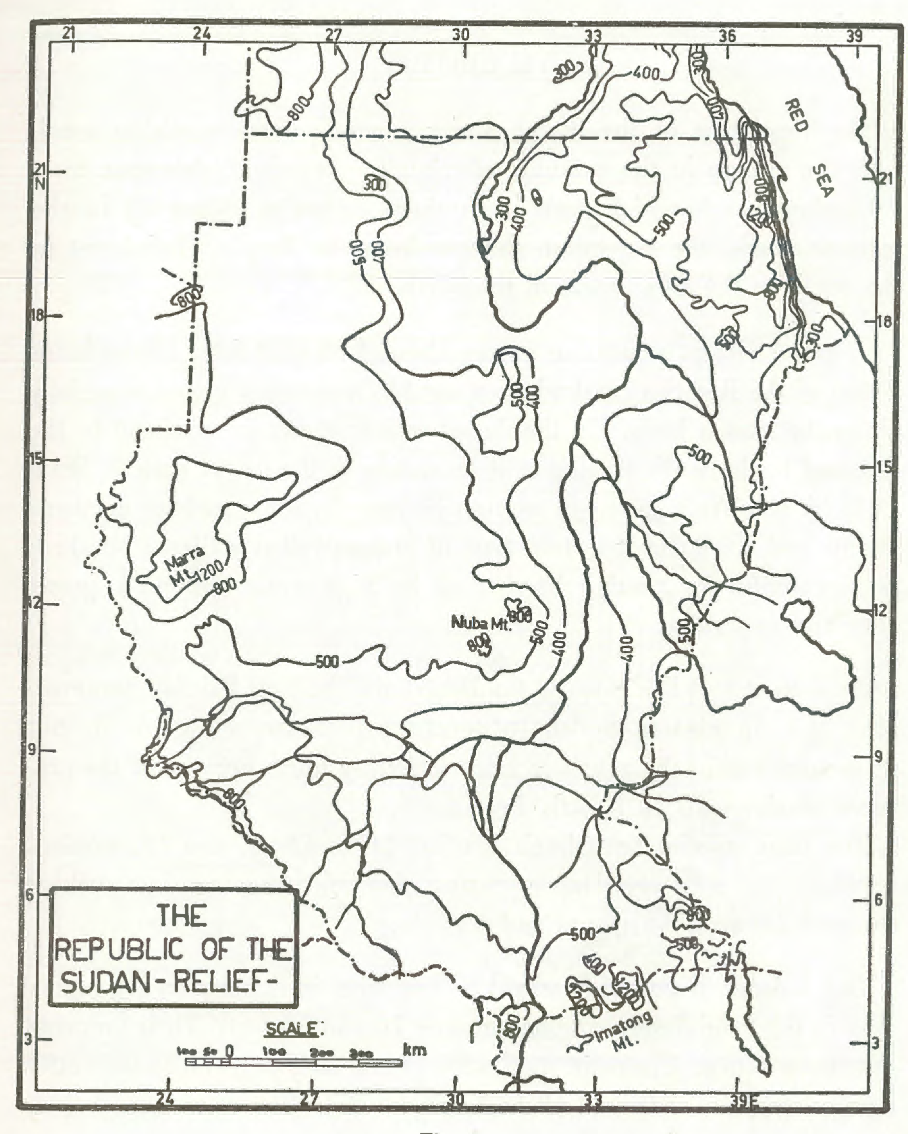


Fig. 1.

The influence of the Red Sea as a water body on the climate of the Sudan is very slight and it is not felt in places lying few miles from the coast.

VEGETATION

The vegetation of the Sudan varies generally from north to south with the change in the amounts of rainfall. As rainfall decreases from 80 inches in a few high parts in southern Sudan to almost nil in the extreme north, the vegetation changes from the Tropical Rainforest in the south to the true desert in the north.

Desert : Desert vegetation covers about 280,000 S.M. It excludes a part of the Red Sea coast where a scrubby vegetation grows, especially along the stream beds. In the desert region plants are confined to the Nile and to the wadis flowing to it or ending in the desert such as Wadi El Melik and Wadi Hawar in western Sudan. In some parts of northern Darfur and Kordofan a certain type of grasses called « Gizzu » — which is very useful for grazing because of its high water content — grows after the first rains.

Semi-desert : It lies between the Desert and the Low Rainfall Savannah (Fig. 2). In western Sudan its southern boundary is at 14° N, but in eastern Sudan the southern limit is farther north because of the presence of clay soils in Kassala Province [1].

The main species are (*Acacia tortilis*), (*A. melifera*), and (*A. etbaica*). Where the soils are deeper grasses grow and trees are less such as the area between Khartoum and Kassala.

Low Rainfall Woodland Savannah : The trees in this region are higher than in the Semi-desert ranging between 10 and 15 feet. Their branches sometimes touch. The main species are (*Acacia melifera*), and on the wetter margins (*Acacia seyal*), and (*Balanites aegyptiaca*). There are some broad-leafed species especially the (*Combretaceae*). In some parts grasses are

[1] F.W. Andrews, The Vegetation of the Sudan; in *Agriculture in the Sudan* by Tothill, J.D., pp. 35-38.

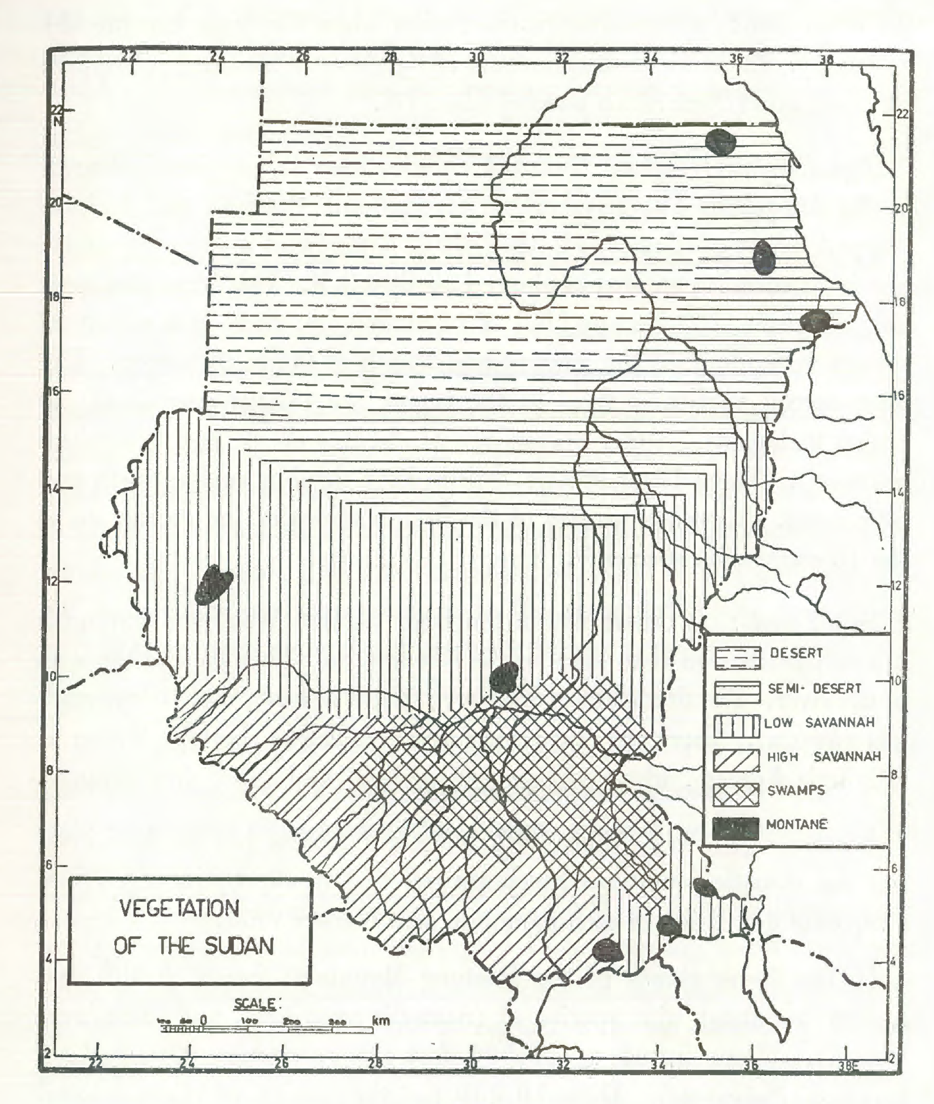


Fig. 2.

dominant and trees are sparse. Acacia trees become established in this region after successive fires that would destroy the grass cover. On the other hand, grasses invade the region when the trees become old and decay. The main grass species are; (*Cymbopogon neruatus*), (*Sorghum purpuro*), and (*Hyparrhenia pseudocymbaria*) [1].

High Rainfall Woodland Savannah : Sometimes this region is known as the Anogeissus-Khaya-Isoberlinia association. Harrison and Jackson mapped this vegetation type in the Bahr El Ghazal and western Equatoria provinces covering an area of about 120,000 S.M. This large area does not, of course, include one kind of vegetation but there is a variety of species depending on the amount and length of the rainy season. The most spread species of trees in the region are (*Khaya senegalensis*) or Sudan mahogany. Other species are (*Isoberlinia doka*), and (*Anogeissus schimperi*). These latter species usually have shrubby undergrowth and little grass. The chief grasses of the drier sections of the region are of the (*Hyparrhenia*) species [2].

Rain Forest : It occurs within the High Rainfall Woodland Savannah in small patches on both sides of the Nile and on higher land to the west of the river. The dominant species are; (*Celtis zenkeri*), and (*Chrysophyllum albidum*). There are also some forests similar to the type known as « Galleria Forest», where (*Khaya grandifoliola*) and other trees appear.

Montane vegetation : Since each mountain section has its individual soil and climatic conditions which are reflected vividly by its vegetation, a separate discussion of each mountain area is more valid.

1. The lower slopes of the Imatong Mountains below 5,000 feet have a woodland with species of (*Boswellia papyrifera*), and (*Terminalia brownii*). From 5,000 to 10,000 feet the species are (*Olea hochstetteri*) and (*Podocarpus*). Above 10,000 feet the species are (*Erica arborea*) and (*Myrica salicifolia*) with many grasses and herbs occurring.

(1) J. Smith, The Distribution of Tree Species in the Sudan, *Ministry of Agriculture, Bull. No. 4*, Khartoum, 1950, p. 11.

(2) *Ibid.*, pp. 12-13.

2. The low slopes of Jebel Marra (below 6,000 feet) have trees like (*Cordia abyssinica*) which appear in the cultivated fields among the growing crops [1]. The dominant grasses are (*Cymbopogon and Hyparrhenia spp.*). Between 6,000 and 8,000 feet there are (*Olea laperrini*) and (*Acacia albida*). Above 8,000 feet the area is covered with grasses mainly (*Hyparrhenia multiplex*) [1].

CLIMATIC DISTRIBUTIONS

In order to get a clear idea about the climatic patterns in the Sudan according to the classifications, we should present a picture of the distribution of climatic elements mainly temperature and rainfall. The choice of these two elements is justified by several reasons; firstly temperature and rainfall are the most important climatic elements in relation to vegetation distribution and other geographic aspects in the landscape. Secondly, all three classifications used in this study depend on temperature and precipitation in the computations of their values and it is relevant to find out the correlations between the patterns of the classifications and those of the climatic elements.

Rainfall : From the map of mean annual rainfall it is noticed that values increase with latitude, hence the pattern of isohyets is generally subparallel over the plains of the Sudan, while it is concentric in the highlands (Fig. 3).

The amount of rainfall reaches 55 inches in the extreme south especially on the highlands and from there they keep dropping untill the desert areas of the north are reached. Areas close to the highlands mainly in eastern Sudan where they are in contact with the Ethiopian Plateau get relatively high amounts of rainfall. Kassala for example gets 13.5 in. which is more than twice the amount at Khartoum (6.5 in.), and both stations are located on the same latitude. The highlands of Jebel Marra and the Nuba Mountains get higher amounts of rainfall in comparison

(1) Barbour, *op. cit.*, pp. 71-72.

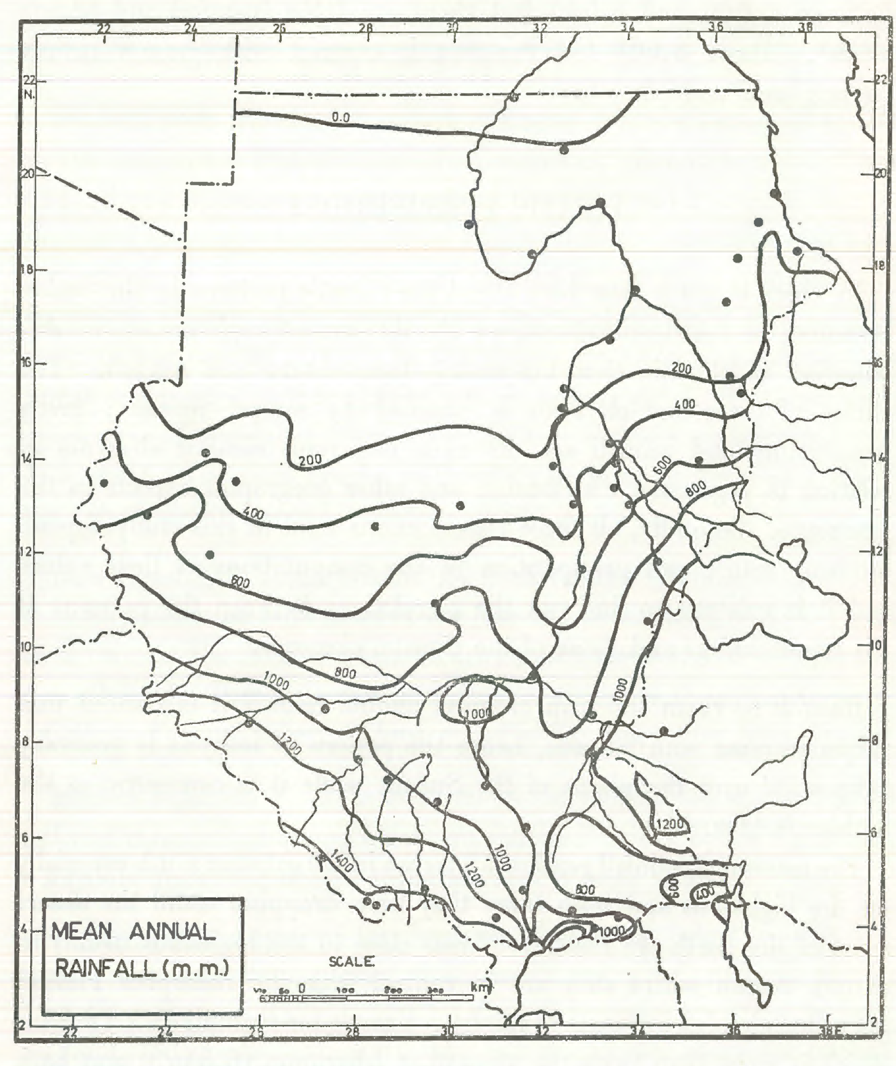


Fig. 3.

with the surrounding areas. The mountains in southeastern Sudan get still greater amounts of rainfall and the values reach in certain limited localities 80 inches.

Temperature : In dealing with temperature it is customary to consider the values for the months of January and July as representatives of winter and summer respectively (in the Northern Hemisphere). However, dealing with the Sudan it was found that January and July do not stand as seasonal averages. The months of mean temperature minimum and maximum are different, from one place to another in the country. Therefore, it is more accurate to study the maps of the mean annual temperature minimum and the mean annual temperature maximum irrespective of the months they fall in.

Mean annual temperature minimum : In the map of mean annual temperature minimum the isotherms are mostly subparallel. Few isotherms are closed around the high mountains especially Jebel Marra and the Imatong Mountains where isotherms are adjusted to terrain (Fig. 4). The high mountains mentioned above include the coldest parts of the Sudan where the mean minima reach 53° F. Minima are the highest in the center of the country where there is a closed isotherm of 72° F covering the area along the Nile valley from Khartoum to Atbara. From this center of warmth, values decrease both northward and southward to reach 64° F in both directions.

It is peculiar to notice that the Red Sea Hills do not have a cooling effect. The values of mean annual temperature minimum increase along the eastern foothills to 75° F which is the highest value for the whole country.

Mean annual temperature maximum : In relation to the mean annual maximum (Fig. 5), the patterns of isotherms are similar to those of the mean annual temperature minimum with a general subparallel pattern over most of the country and few closed isotherms in the mountains sections. The hottest part of the Sudan is the north central portion starting from the latitude of Kosti northward to about the latitude of Dongola.

It is to be noticed that this same area has also the highest mean temperature minima. Temperature maxima decrease from this center of heat toward the north and the south reaching 93° F in the extreme northern part of the Sudan and 90° F in southern Sudan.

The high mountains of western and southern Sudan show a cooling effect and maxima drop to 90° F or less. The Red Sea Hills have a slight cooling influence. On the other hand along the coast the maximum rises up to 93° F.

THE PERFORMANCE OF THE THREE CLASSIFICATIONS IN THE SUDAN

Considering the maps of temperature, rainfall and vegetation distributions in the Sudan it is noticed that in all these geographic patterns there is a general gradient from north to south with the change in latitude. There are few exceptions in the highland sections in the east along the Red Sea; in the west in the Nuba mountains and Jebel Marra and in the south in the Imatong mountains. These highlands portray a different setting because of their altitude. In the highlands temperatures are lower, rainfall amounts are higher and vegetation is usually richer and of a more temperate type.

Moisture conditions according to the classifications : According to *Koppen*, about two thirds of the Sudan are dry, desert or steppe. The (B) climate extends far southward along the Nile valley to include places like Shambe (latitude 7° 7' N). However, the boundary between the Steppe (BS) and the humid climate (A) swings northward in eastern and western Sudan where places like Kurmuk (latitude 10° 33' N) in the east has an (A) climate and Kadugli (latitude 11° oo N) in the west is also included within the humid region (Fig. 6).

The highlands probably have (C) climate differentiated on the basis of temperature conditions in winter, yet consequently considered humid.

The boundary between the desert region (BW) and the steppe region (BS) runs almost with latitude 14° North with few bends to the south in the Nile valley and northward in the eastern and western margins

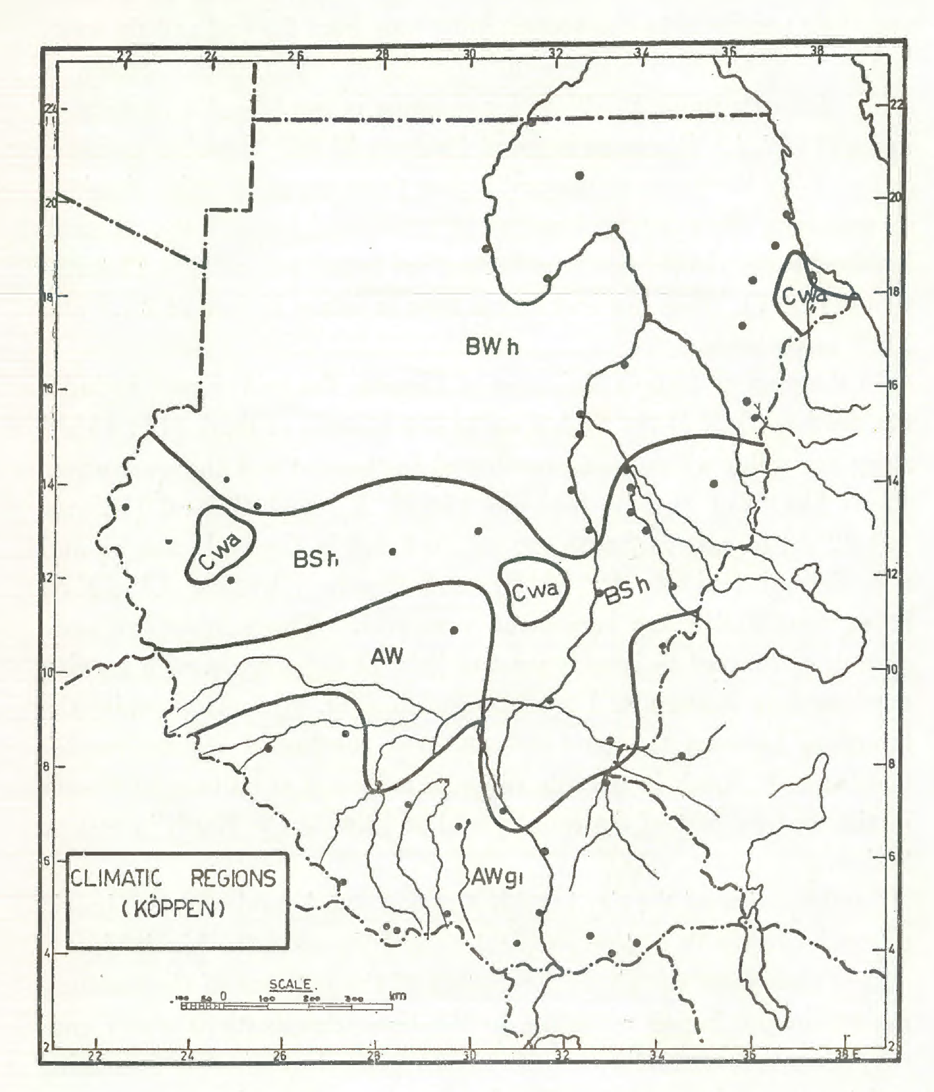


Fig. 6.

where it is close to latitude 18° North. This condition is obviously a result of the higher altitudes in those marginal portions of the country and their proximity to the oceanic influences from the east and the west.

According to *Thornthwaite's* moisture index, most of the Sudan is arid. Juba (latitude 4° 52' N) for example is considered arid with an index of -42.9. The same is Aweil (latitude 8° 46' N) with a moisture index of -42.8. South of the arid region there are small strips classified as semi-arid, dry sub-humid and moist sub-humid respectively. A small highland section in the southeast is classified humid according to Thornthwaite (Fig. 7). Nagishot and Katrie have moisture indices of 35.5 and 26.2 respectively.

In the map of *Bailey's* Moistness of Climate, the arid climate includes the northern half of the Sudan up to the latitude of Renk (11° 45' N) along the valley with a bend northward in the east and the west where places like Wad Medani (latitude 14° 23' N), and Gedaref (latitude 14° 02' N) in eastern Sudan are not included in the arid category and also Zalengi (latitude 12° 54' N), and Geneina (latitude 13° 29' N) in western Sudan are considered semi-arid. The semi-arid climate extends southward to include most of Bahr El Gabal basin with a swing northward in eastern and western Sudan (Fig. 8). Thus while the boundary between the semi-arid and the sub-humid regions reaches to latitude 5° North in the Nile valley, it is located at latitude 10° North in the western part of the country and at latitude 12° North in eastern Sudan.

Narrow strips of the dry-humid, the wet sub-humid and the humid categories follow in a steep gradient toward the southern highlands.

It is clear from the above description of the patterns of the moisture regions in the Sudan according to the three classifications under consideration that all of them agree on the general gradient of increasing moisture toward the south. The increase in moisture is more apparent in eastern and western Sudan than in central Sudan, an effect of the high altitude. However, there are differences among the three classifications. Thornthwaite's classification shows the northern three quarters of the Sudan as arid. In the maps of Koppen and Bailey, the location of the arid boundary is father north. Koppen's and Bailey's

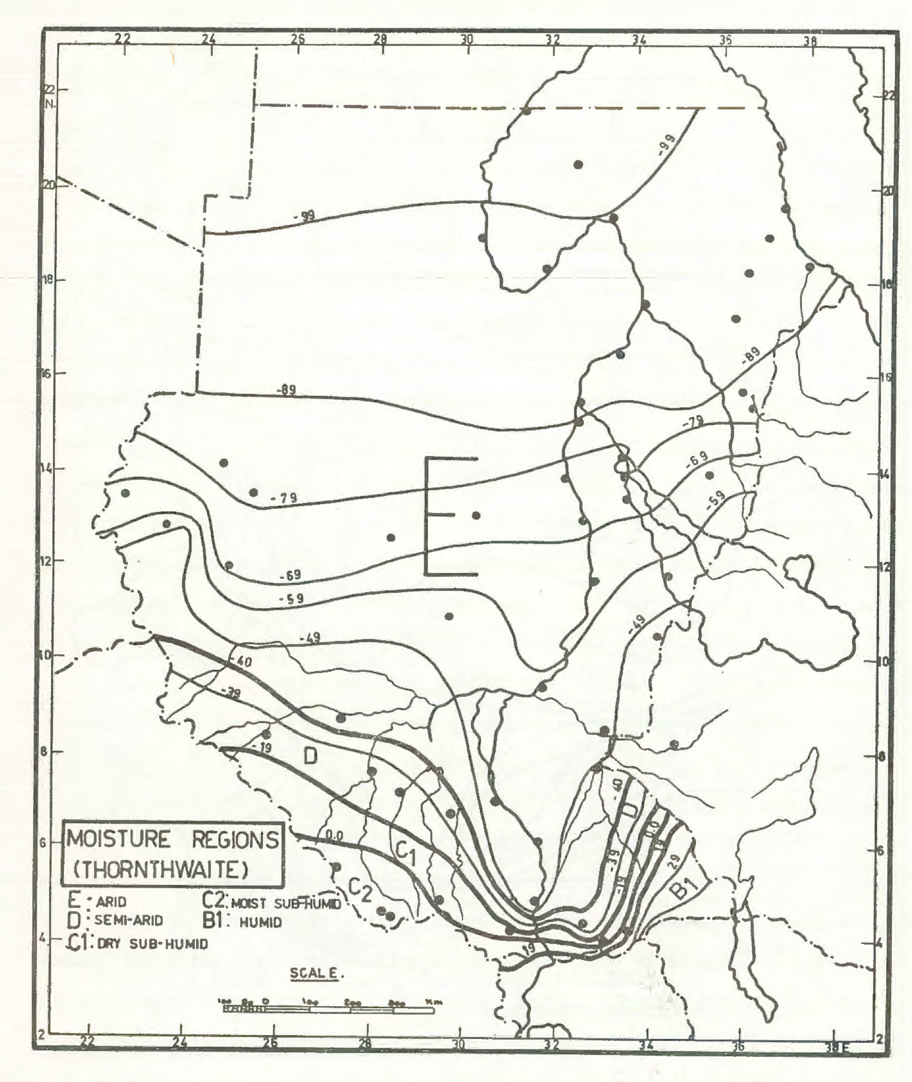


Fig. 7.

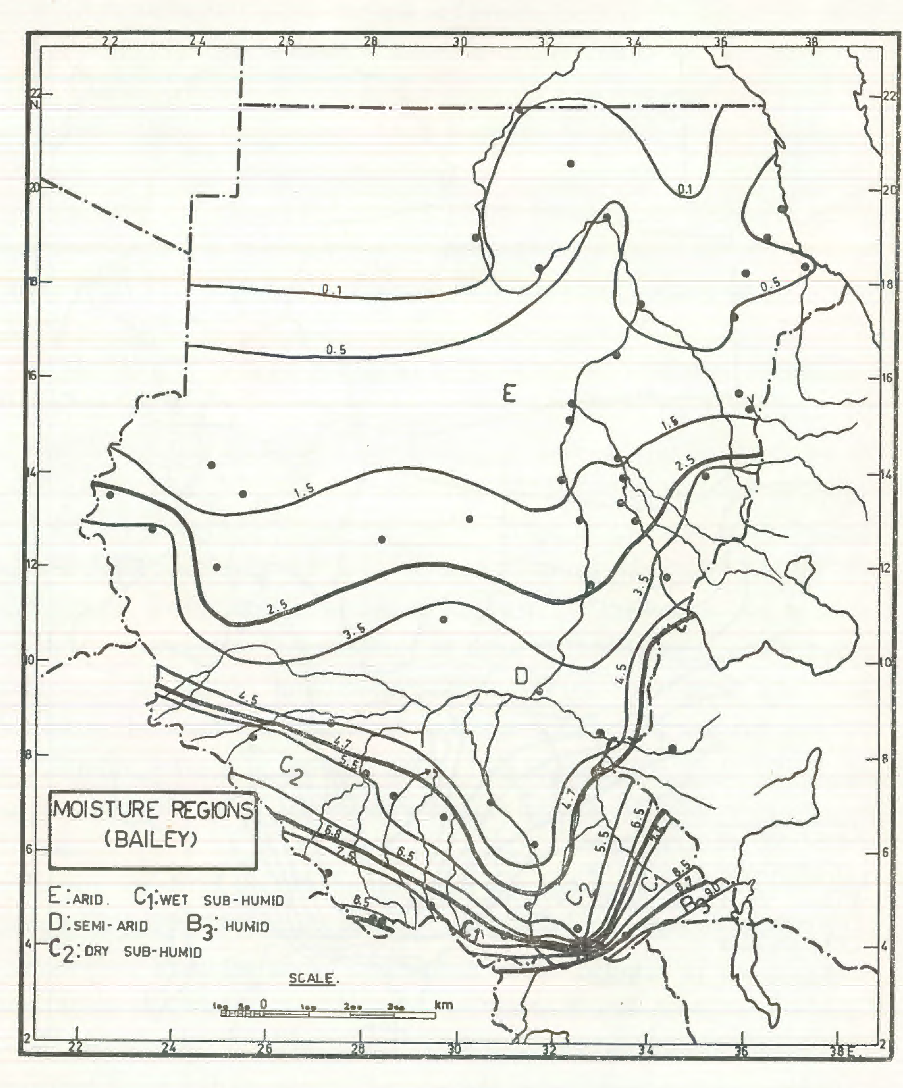


Fig. 8.

arid/semi-arid boundary is in good correlation with the boundary between the semi-desert and the low rainfall woodland savannah in the vegetation map. There is no master boundary between the desert and semi-desert in the map of Bailey's moistness of climate, yet the *0.5* isoline shows a good correlation with the southern boundary of the desert region.

The southern boundary of the semi-arid category in the maps of Koppen and Bailey are almost the same, both have a good correlation with the vegetation boundary between the low rainfall woodland savannah and the high rainfall woodland savannah. Thornthwaite's boundary between the semi-arid and the sub-humid categories is far to the south. The extreme dryness shown by Thornthwaite's scheme in the Sudan — as compared with the other two schemes and with the vegetation types-results from the influence of the high values of potential evapotranspiration for this part of the world. It is obvious that the values of potential evapotranspiration are very high when summer temperatures are high. High summer temperatures are characteristic of most parts of the Sudan. The amounts of rainfall are always lower than the values of potential evapotranspiration and the result is — of course — high values for the water deficit or in other words a rather dry climate. The broad area of the arid climate in the Sudan according to Thornthwaite's scheme cannot be justified. Juba for example is considered arid, while in the vegetation map it is included in the high rainfall woodland savannah.

Koppen's and Bailey's schemes show better correlations with vegetation distributions. The lack of a moisture boundary between the desert and the semi-desert can be compensated for in the map of Bailey by one of the field lines since the scheme supplies a continuous field of values over the surface. On the other hand, Koppen's classification is handicapped in this respect for supplying master boundaries only. The high value for the boundary between the desert and the semi-desert in Bailey's map could be attributed to Bailey's concept of the desert which might be different from its concept in the minds of the authors of the vegetation map of the Sudan. Travelling in western Sudan, the author of this paper thinks that the boundary between the desert and the semi-desert in the vegetation map is put far northward. Kutum for example

which is included in the low rainfall woodland savannah has an annual amount of rainfall of about 9 inches and rainfall effectiveness is expected to be low because of the high temperatures of the area. The landscape in the area is one of scattered low grasses that can be designated as semi-desert at most.

Thermal conditions according to the three classifications : According to *Koppen,* the only major differentiation in thermal conditions in the Sudan is between the 'C' climate and the other climates. This divisioning is a mere interpolation since there are no weather stations on the high mountains. The areas included in the 'C' region are very limited to altitudes over 6,000 feet above sea level where mean monthly temperatures in winter are expected to drop below 64.4° F. The areas having 'C' climate are designated in the vegetation map as (Montane vegetation) where species like (*Boswellia papyrifera*) and (*Terminalia brownii*) are found.

A slight or a secondary divisioning based on differences in temperature ranges is shown in the southern part of western Sudan where the small letter (i) does not apply. The temperature ranges in that part of the Sudan are thought to be greater than 9° F because of the pronounced seasonality in rainfall and insolation.

Southern Sudan according to Koppen has a tropical climate with a small mean annual range of temperature and a temperature maximum occurring before the date of the summer solstice. This — of course — is different from the central and northern parts of the country where temperature ranges are much greater. Mean annual temperature ranges reach 25.0° F at Abu Hamad in northern Sudan (latitude 19° 32' N), while they drop to 6.0° F at Maridi in southern Sudan (latitude 4° 49' N).

In *Thornthwaite's* thermal efficiency map only one category exists. The whole country is classified as Megathermal (Fig. 9). The field lines drawn in the map show an increase in the values of potential evapotranspiration from the northern part of the Sudan to the center, then a decrease from there southward. Values are low in the mountain areas such as in the south and the west (Nagishot in the south has a value of 32.4 inches and Zalingi in the west 48.1 inches).

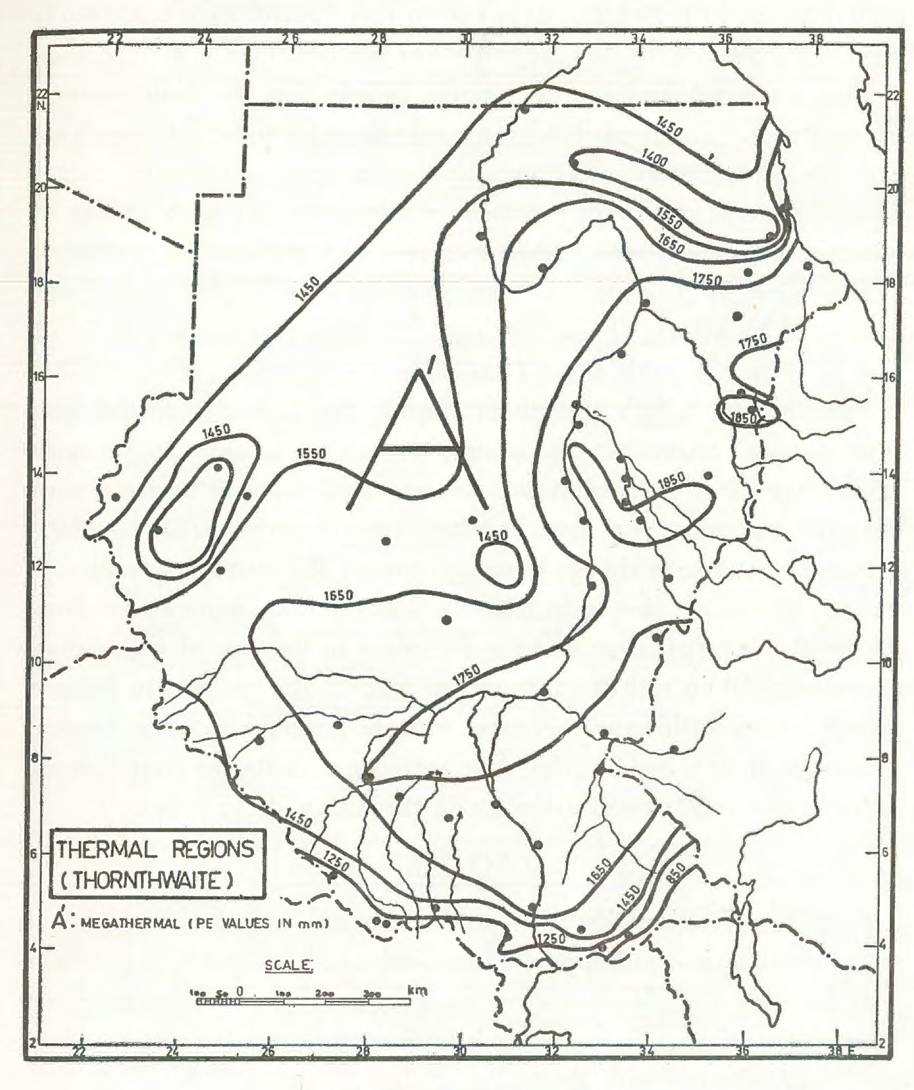


Fig. 9.

The high values of potential evapotranspiration result from the high summer temperatures in the Sudan in general and in northern and central Sudan in particular. It is known that Thornthwaite's scheme is very much affected by the high summer temperatures. Winter temperatures are not very low to counter balance for the high summer temperatures. The result is high annual values for potential evapotranspiration. It was mentioned previously that the great aridity of the Sudan according to Thornthwaite's scheme results from the high values of potential evapotranspiration when compared with the amounts of rainfall.

The failure of Thornthwaite's classification in a tropical region was discovered by others. Fuson applied the system to Panama and found that it does not work there (Professional Geographer, May, 1963).

According to *Bailey's* warmth of climate, the Sudan is divided into three thermal categories; the central part of the country is hot with values over 70. Thermal values decrease from this hot center toward the north where the very warm and the warm categories occur (Fig. 10). The same sequence of change is noticed toward the south and south-east but the gradient is steeper in this direction especially upon approaching the highlands. It is clear that the *ET* values in the map of Bailey show a close correlation with the temperature maps. The patterns in Bailey's system are reasonable and they agree with the general idea about thermal conditions in the Sudan. No clear correlation exists between thermal patterns and vegetation distribution in the Sudan.

CONCLUSION

From the preceding discussion on the climate of the Sudan according to the classifications of Koppen, Thornthwaite and Bailey we can conclude that the three classifications agree on the general trend of moisture and thermal conditions. Vegetation distributions are correlated with moisture conditions and not with thermal conditions.

Koppen's and Bailey's moisture boundaries proved to be better than Thornthwaite's boundaries. In relation to thermal and moisture regions Thornthwaite's values are too high in the former and too dry in the latter as compared with vegetation types and with the categories in the other two classifications.

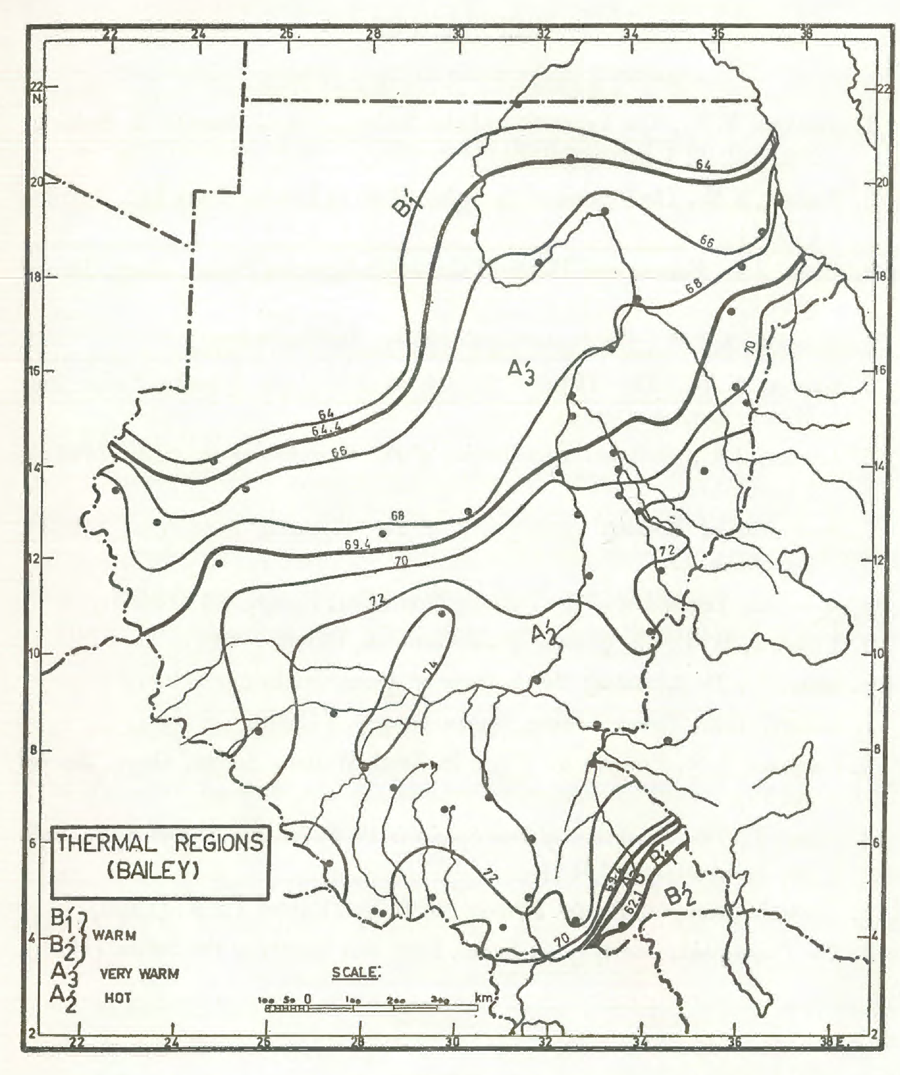


Fig. 10.

REFERENCES

1. Andrews, F.W., The Vegetation of the Sudan, in *Agriculture in the Sudan* by J.D. Tothill, London (1948).
2. Barbour, K.M., *The Republic of the Sudan,* Univ. of London Press Ltd. London (1961).
3. Chipp, J.F., Forests and Plants of the Anglo-Egyptian Sudan, *Geogr. Journal* (1930).
4. Gleichen, A.E.W., *The Anglo-Egyptian Sudan,* Dublin (1905).
5. Graham, G.W., The Physical Setting in *The Anglo-Egyptian Sudan from Within,* London (1955).
6. Jackson, J.K., *Ecological Classification of the Vegetation of the Sudan* (1955). Unpublished.
7. —— *Detailed Botanical Descriptions of the Vegetation Subdivisions* (1955). Unpublished.
8. —— The Vegetation of the Imatong Mountains, *Ecology,* 44 (1956).
9. Kendrew, W.G., *The Climates of the Continents,* Oxford (1922).
10. Knox, A., *The Climate of the Continent of Africa,* Cambridge (1911).
11. Massey, R.E., *Sudan Grasses,* Sudan Govern. (1926).
12. Sandford, K.S., Sources of Water in North-Western Sudan, *Geogr. Journal* (1935).
13. Smith, J., *The Distribution of Tree Species in the Sudan,* Ministry of Agric. Bull. No. 4, Khartoum (1950).
14. *Sudan Meteorological Service,* Memoir No. 6. by Bhalotra Y.P.R. (1963).
15. *The Philosophical Society of the Sudan,* Food and Society of the Sudan (1955).

THE « BULLETIN DE LA SOCIÉTÉ DE GÉOGRAPHIE D'ÉGYPTE » A REVIEW OF ITS VOLUMES, 1875-1965 [(1)]

BY

Dr. Y. TONI

In ten years time the Geographical Society of Egypt (born in 1875) will celebrate its first centenary. However, no assessment of the volumes and publications for which the Society has been responsible during all that period has ever been made. It is perhaps appropriate to review the achievements of the Bulletin as a patron and supporter of geographical knowledge in this country at the time when plans are being made to hold the first regional conference for Arab Geographers.

The initial object of the Society, as stated in the « *Statuts* » of 1875 was twofold :

« (a) *To study Geography in all its branches* » ;

« (b) *To throw light on the African territories which are still unexplored or little known* » [(2)].

However, in the « *Règlement intérieur de la Soc. Khédiv. de Géogr.* » [(3)] and in G. Schweinfurth's Presidential Address [(4)] much emphasis was

(1) The *Bulletin de la Société de Géographie d'Egypte* succeeded *Bulletin de la Société Royale de Géographie d'Egypte* (1922-1952), *Bulletin de la Société Sultanieh de Géographie du Caire* (1917-1922), and *Bulletin de la Société Khédiviale de Géographie du Caire* (1875-1917).

(2) *Statuts de la Société Khédiviale de Géographie,* article 2, p. 5 (printed in Alexandria, 1875), also the *supplément* to vol. I and vol. VIII, p. xvii-xxvii.

(3) Under « *V. Publications* », p. 10 (printed in Alex., 1876).

(4) *Discours prononcé au Caire à la Séance d'Inauguration le 2 Juin 1875,* published in the *Bulletin,* vol. XIV, 1926, p. 113-127, esp. p. 121.

laid on the second aim, i.e. African discoveries, but not to the total or frank exclusion of the first one. This is to be expected since the Society was one ' of geography ' not ' of geographers '. The period in which the Society was born was, everywhere, one of fervent ' geographical discoveries ' not of ' geographical research '.

Later the statuate has changed twice, the first time in 1917 when the aim was modified to « ... *study and encourage the sciences pertaining to Geography, especialy the geography of Africa, Egypt and the adjacent territories*» [1], and the second in 1956 « ... *its aim is to encourage and promote the geographical studies and allied sciences, with special regard to the geography of Africa, Egypt and the Arab World*» [2]. But interesting though these changes were in the life of the Society in general, they had little bearing on the development and growth of the Bulletin, except perhaps in recent years when a substantial number of non-geographical papers have crept into the pages of the Bulletin. One is tempted to ask if this was done mainly to conform with the statement « ... *and allied sciences*» of the 1956 statuate. On the contrary, however, it seems that changes in the Statuates were probably made to suit the changing character of the Society's Bulletin. The inclusion of the ' *Arab World* ' in the 1956 statuate, as another region of special interest, is only a reflection of the increasing number of papers dealing with this area and published by the Bulletin. Likewise, the admission of ' *allied sciences* ' in the same year probably bears the same implication.

However, more recently the Bulletin has come to what may be called a new function — a publishing medium for professional geographers and allied scientists in the U.A.R. The Society itself has practically ceased to be a « layman's Society», rather it is becoming a « Professional Society» with a dues-paying membership of less than 130 in recent years. This low figure, if compared with 344 in 1876, when the Society was only one year old, or with 434 in 1922 or with 567 when it reached its maximum in 1926 may be taken as an indication of its special or

(1) *The Statuate of the Egyptian Royal Geographical Society,* 11th August 1917 (in Arabic), p. 1, Cairo 1941.

(2) *The Statuate of the Egyptian Geographical Society,* 1956, p. 4 (in arabic), Cairo 1958.

professional status, rather than the former « general» position. Articles presented for publication are almost all written by specialists in their fields. Gone was the time when the Bulletin catered for explorers, naturalists, army-officers, colonialists, and heterogeneous scientists. The Bulletin has no room for the polygraphs anymore.

The present potent situation, therefore, makes advisable a short review of the past. This does not pretend to be a full account of the history of the development of geography in the Society or its periodical, rather it is a brief survey of the contents in the early and more especially the later volumes of the Bulletin.

For convenience we may divide the life history of our Bulletin into two main periods : the first 50 years, 1875-1925, when the Bulletin was fulfilling its original function, i.e. explorations in Africa and the Egyptian deserts; and the second 40 years, 1925-1965 when a considerable amount of research was undertaken first by foreign and later by Egyptian geographers and allied scholars. The definite time (1925) given to the end of the first period is, of course, open to criticism, but the writer bases his interpretation on the signs of new life in Egyptian geography as shown by the establishment of a modern University in Cairo. Furthermore, the universal progress of geography during the first half of this century also gave a new impetus to geography in Egypt. Other sub-divisions, however, are bound to occur, but they are not watertight and must not be taken as hard and fast frontiers. In several cases personalities, characteristics and emphasis of one particular field or another overlap from one period to the next.

I. — THE FIRST FIFTY YEARS.
(1875-1925)

The history of the Society during this period has been dealt with in two publications, one in 1921 [1], the other in 1925 [2] celebrating its

(1) G. Foucart et A. Cattaoui, *La Société Sultanieh de Géographie du Caire : Son Œuvre (1875-1921)*, Publications Spéciales de la Soc. de Géogr. d'Egypte, 1921.

(2) A. Cattaoui, *Célébration du Cinquantenaire de la Société,* vol. XIII, 109-129.

fiftieth anniversary, but both generally consist of adresses delivered at ceremonies and tend to be more laudatory than critical. It is perhaps appropriate to subdivide this half-century period into two : the late nineteenth century 1875-1900 and the early twentieth century 1900-1925.

The Late Nineteenth Century, 1875-1900

In the seventies of the last century, the largest number of Geographical Societies in the World [1] was founded. Egypt was no exception. This was the period of the partition of Africa, as well as the upsurge of national feeling.

During the period from its establishment until nearly the end of the 19th century, the Bulletin was almost wholly engaged in exploration, mapping and surveying in Africa. Egypt at that time was custodian of much land in the Sudan and East Africa [2]. Surveys were required and many Egyptian officers undertook pioneer work with the American staff of the Egyptian army in the Upper Nile region, Somaliland, Eastern and Western Sudan. During the five years preceding the formal establishment of the Society, General Stone Pacha declared, « ... de 1871 à 1875, l'Etat-Major égyptien a organisé dix-huit expéditions scientifiques au cœur de l'Afrique [3] ». Thus the first two volumes (Series I and II) included papers by Colonel Mohamed Mokhtar, « *Notes sur le pays de Harrar* » [4], « *Une reconnaissance au pays des Gadiboursis* » [5], « *Dans le Soudan oriental* » [6], and by Abdalla Faouzi and Nahdi Pasha on *Harrar*,

(1) Throughout the world 15 Societies made their appearance between 1820-1870, 58 in 1870-1880, 10 in the 1890's, 11 in the 1900's, 10 in 1910's and 31 in 1920's (J.K. Wright, « The Field of the Geographical Society » in *Geography in the Twentieth Century*, p. 548).

(2) In 1882 a map showing the Egyptian possession in Africa was compiled under the supervision of General Stone Pacha (an American in the Egyptian Army) to a scale of 1 : 1000,000.

(3) XII, 113.

(4) References to articles in the *Bulletin de la Société de Géographie d'Egypte* are given herein and after in their numerical form only. I No. 4, 351-397 and No. 5, 14.

(5) I No. 7, 5-17.

(6) I No. 11, 5-18.

as well as their American colleagues : General Stone, « *La topographie et la géographie du pays entre la côte de la mer Rouge et le plateau abyssinien* » [1], « *La découverte du lac Albert-Nyanza et ses resultats scientifiques* » [2], « *Note sur la géographie de l'Abyssinie, d'après des rapports de l'Etat-Major égyptien* » [3] Purdy and Colston. Their papers ranged from Upper Egypt to lake Albert, and from the Red Sea area to Kordofan and Darfour. The Egyptian Department of War carried on the early military and land surveys. In Arabia, Colonel Mohamed Saddik Pasha wrote about his voyage to Mecca and the Higaz during the reign of Saïd.

European explorers, however, who contributed papers to the Bulletin, covered a much wider area than their Egyptian and American contemporaries. West Africa, for example, is represented in the first three volumes by such explorers like P. Jourdan, Dr. Güssfeld, le marquis de Compiègne and J. Borelli. East Africa, however, including Abyssinia and the Sudan accounts for about 70% of all articles written on Africa during this early period. General Gordon, Slatin Pacha, Castro, Mitchell, General Stone, Nahdi, Mokhtar Bey, Faouzi Bey, Colonel Colston, Colonel Mason, Purdy Pacha, were among the many contributors to the Bulletin. Their accomplishments and papers were quite significant to the expanding functions of the government of Khedival Egypt. Even Central Africa had a proportion of about 23 %, and names like Junker, Wissmann, Linant de Bellefond, Nachtigal, Piaggia, Borgassi, Casati, Chaillé-Long, Compiègne and others flash brightly in the early numbers of the Bulletin.

The contents were mainly itineraries of expeditions and explorations, surveys and reports, maps and charts, all an integral part of the discovery and advancing knowledge of the African continent, a tradition that has persisted in the pages of the Bulletin down to the 1920's.

Causes for this are not difficult to seek. Situated in the world's greatest gathering place of explorers to Africa, the Egyptian Geographical Society of Cairo has adhered to this tradition more consistently, perhaps,

(1) I No. 9 and 10, 43-76.

(2) I No. 5, 18-27.

(3) I No. 8, 38-39.

than have its European ans American counterparts. Cairo has always been the main gate-way to the interior of Africa. It was from Cairo that most explorers and scholars went to the unknown parts of this continent; but equally important was the fact that Cairo was the inevitable halting place on the return journey. There were also those contributors who have devoted much time and energy to compiling and editing the results that followed after every expedition. This was indeed the golden age of African discoveries, the fabulous period of explorations in the Congo, the Great Lakes region, Uganda, the sources of Ouella, and that of Lake Albert, the Kingdom of Niam-Niam, and the reconnaissance of the Nile Basin. The Bulletin presented a wealth of material, indispensable for all interested in Africa; politicians, adventurers, district-commissioners, scientists, businessmen, and others. The adventure and romance of exploration appealed to the imagination, its political implications to all colonial powers, and its commercial potentialities to the more worldly inclinations of the Society's heterogeneous memberships. Many papers bear the fruit of exploration and annexation of wide and extensive areas in Equatorial Africa to Khedival Egypt. Abbate Pacha, one of the early presidents of the Society, went as far as to say that, « La Société de Géographie.... n'était que la conséquence des conquêtes du Soudan, opérées par Mohammad Aly, conquêtes qui ont ouvert ces vastes possessions de l'intérieur de l'Afrique aux grands pionniers de la géographie et qui ont produit la plus grande des découvertes, celle des sources du Nil.... » [1].

The Early Twentieth Century 1900-1925

In the later part of the 19th century the Bulletin began to lose ground in African explorations. The age of discoveries, adventures and romance has come to an end. Khedival Egypt was no longer seeking African territories. Egypt itself fell under foreign domination. It was the end of the era of great discoveries. Very little was left to be explored in the « Dark Continent». Vol. V, published in 1902, contained articles on

[1] VI, No. 9, 1905, p. 25.

Mahdism, Egyptian plants, meteorology, antiquity, aviation, sponge fisheries, an Egyptian museum of ethnography, the Egyptian fellaheen, and even medical geography; but only three papers on exploration [1], J.B. Piot and Bonola appropriately wrote, in the same volume, a short paper on « *Les derniers voyages en Afrique*» [2].

The period 1900-1925 is perhaps best regarded as a transitional period between the years of discovery and exploration in the latter part of the 19th century and the more geographical approach of the Bulletin after 1925. Patriotic pride, due to the growth of national feeling, before and after the 1st World War, stimulated many resident members to take keener interest in the internal geography of the country. The Bulletin had to substitute its activities from African exploration to local studies, or studies of explored areas, opening wide the gates to new branches of geography, especially to ethnology and historical geography of the Nile Valley. This was particularly the case in the period between the 1st World War and 1925.

As early as 1890, however, a marked interest in the geography of Egypt is shown by such articles as Bonola's. « *La question des noms géographiques en Egypte*», Moncrieff « *Note sur le Wadi Raian*», Robecchi-Bricchetti « *Une excursion à Siwa*», Abbate Pacha « *L'Egypte dans ses rapports géographiques anciens et modernes*», all of which appeared in vol. III of the Bulletin. In volumes IV and V, however, more and more articles on Egypt appeared, establishing a definite interest in home affairs, which a subsequent decline the number of papers dealing with African discoveries.

Only three volumes appeared interruptedly between the turn of the century and the First World War. With the economic crisis a temporary cessation of the Bulletin was necessary. The early part of the twentieth century roughly corresponds to the time when Dr. O. Abbate Pacha

[1] (*a*) Col. L. Castro, *De Zilah au Harrar, Notes de voyage,* vol. V, 133-161.
(*b*) R. Fourtau, *Voyage dans la partie septentrionale du désert arabique,* vol. V, 515-577.
(*c*) Dr. B. Moritz, *Excursion aux oasis du désert libyque,* vol. V, 429-475.
[2] V, 787-789.

(a medical doctor, formerly of the khedival and royal house, but an excellent polygraph) took presidency over the Society for a period of 25 years, from 1890 to 1915. This transitional period in the life history of the Bulletin is one of gradual change before the outbreak of the 1st World War and a sharp turn towards history, archaeology, and historical geography after the war when G. Foucart (a French ethnologist) was president of the Society.

Unlike those of the first period, the contributors of the second period were almost all foreigners by birth. Practically none was a professional geographer, but many were excellent polygraphs, and some were ardent egyptophils. Names like Abbate Pasha and Bonola Bey appeared currently in almost all volumes of the Bulletin during that period. Abbate in particular was quite prolific. He contributed no less than 32 papers during the time of his presidency, an average of about 6 articles in each volume.

Between the end of the 1st World War and the year 1925 the Bulletin appeared more regularly, with one volume nearly every year. This was more or less the period when G. Foucart was president of the Society. Under his presidency, a major activity of the Society continued to be the publication of a Bulletin as a medium of research carried out by the polygraphs, the historians, the ethnologists, the egyptologists and the amateur geographers. Very few differences exist between this period and the pre-war years. However, a growing number of papers in English began to trickle through the almost entirely French, or French and Italian, pages of the Bulletin. Willcocks on irrigation, Hume on geology, Wainwright on ethnology and Haswell on historical geography, were among the outstanding British contributors. A significant item in the Bulletin during the post-war period was the publication of a bibliography, especially of works on the historical geography of Egypt, compiled by H. Gauthier. An average of 17 pages in each volume was devoted to the « Bulletin bibliographique» from 1920 to 1925. It was after 1925, however, that a comprehensive and systematic ‘ Bibliographie géographique de l'Egypte ’ appeared currently in all volumes up to 1933.

Perhaps the most outstanding feature of the post-war period (1920-1925) was the disproportionate bias towards ethnology. Foucart, then

president of the Society, was himself an eminent ethnologist. A proportion of approximately 3 to 5 articles in every volume during this period was in one way or another related to ethnology. In vol. XII (1923) and XIII (1924) a catalogue of the ‘ Ethnographical Museum ’ of the Society was compiled by E.S. Thomas taking up more than one-fifth of the size of each volume. In 1922 when the Society decided to invite geographers to an international congress, it was to a congress of « Geography and Ethnology» to be held in Cairo in 1925.

The Egyptians who contributed papers to the Bulletin at that time were mainly of the nobility and the royal house. Ahmed Hassanain Pacha wrote about his famous journey through the Libyan desert (XXII p. 181). Prince Haidar Fazil, Prince Youssef Kamal, Ismail Sidky Pacha, Moustafa Maher Pacha, Hafez Afifi, and Moustafa Adham were all illustrious names in the Royal period.

Dates of publications show many gaps, sometimes over long periods (Fig. 1). From the date of its first appearance until the 1st World War there were 7 gaps, the largest continued for 5 years — between vol. V in 1902 and the next volume in 1908. From 1920, however, the Bulletin appeared more or less regularly with only two one-year gaps in 1938 and in 1952, but with two volumes in 1953. The interrupted nature of the Bulletin in its early years is partly ascribed to the financial difficulties which Egypt as a whole was suffering, and partly to the war years of 1914-1919, though one volume appeared in 1917 when King Fouad I (then Prince) was president of the Society. The period of discontinuity coincides well with the time when Dr. O. Abbate was president of the Society. Under Foucart, Hume, Sabry and Amer the Bulletin appeared fairly regularly. The two volumes in 1953 obviously account for the one which was not published in 1952.

II. — THE LAST FORTY YEARS. (1925-1965)

The year 1925 is almost the watershed between the old and the new geography. Up to that time the definition of « Geography» and « geographer» was loose, wide and extensive. Among those who were working

in their various ways to advance the subject there were scholars in biology, archaeology, egyptology, ethnography, geology, palaeontology, as well as the explorers and the army officers of the early formative period. The year 1925, however, is memorable for in that year a new period dawned in Egypt. The ‘ Egyptian University ’ of Cairo was officially established, and a growing number of professional geographers — both foreign and Egyptian — took active interest in the Society and its Bulletin. In line with the spirit of the time, this was a period of much geographical ferment and progress, acadamically as well as from the research point of view.

As with the first fifty years of the life history of the Bulletin it is perhaps appropriate to distinguish two main periods in the last forty years, similarly divided by the 2nd World War : the 1925-1945 period when a substantial amount of research continued to take place in the fields of ethnology, archaeology, history, but with a definite and fuller recognition of geography, especially historical geography; and the 1945-1965 period when more Arab geographers with more varied geographical interests began to invade the pages of the Bulletin and gradually changed its character from a foreign, intellectual, Layman's Society magazine to a national, academic, professional society journal.

The Pre-War Period, 1925-1945

Two major events in the year 1925 have had considerable influence on the changing character of the Bulletin. One was the meeting of an international body of geographers to attend the first International Geographical Congress (4th to 9th April 1925) in Cairo. The other was the formal establishment of an ‘ Egyptian University ’ in Cairo in the same year.

The Congress was organized by the Society, but in theory it was placed under the patronage of the International Geographical Union and regulated by its statutes. As early as 1922 an organizing committee under the chairmanship of Adli Yakan Pacha, including G. Foucart (President of the Society) Cattawi Bey (General Secretary) P. Lacau (Director of the Department of Antiquities) was appointed to prepare

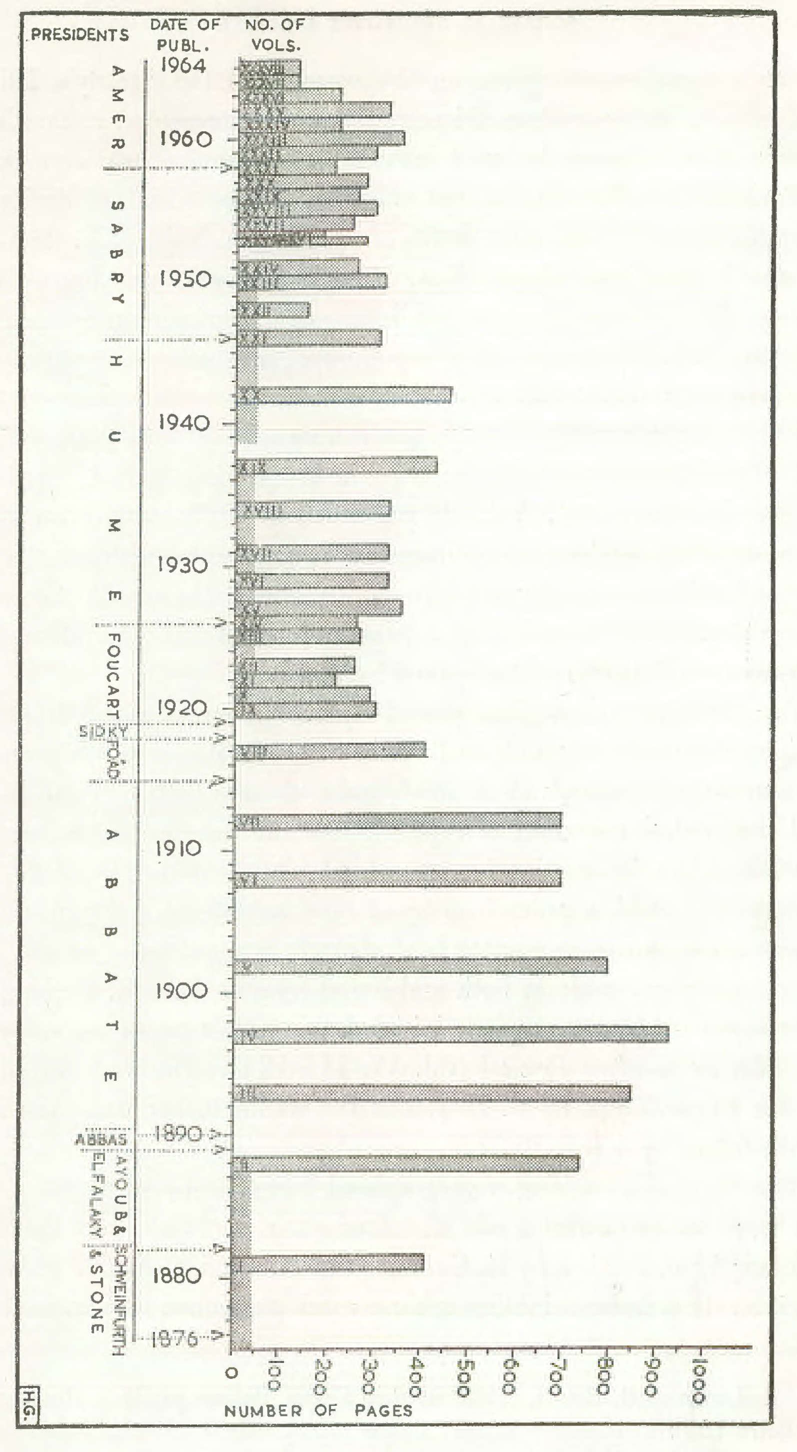


Fig. 1. — Volumes of the *Bulletin de la Société de Géographie d'Egypte*, 1875-1965.

for an international congress on the occasion of the Society's fiftieth anniversary. Delegates from 31 countries were represented in the Cairo Congress, and among the most interesting communications were those of Emmanuel de Martonne on the extension of areas of inland drainage, Henri Baulig on the idea of a profile of equilibrium, Major M.N. MacLeod on the International World Map, Henryk Arctowski on climatic variations, Albert Demangeon on the influence of agricultural systems on the forms of settlement in Western Europe, and numerous papers on the geography of Egypt.

The tendency to embrace subjects which were not strictly geographical, and of which there was some evidence in the previous period, has been progressively narrowed. Vol. XIV published in 1926 contained a wider representation of the various branches of geography with articles on physical and economic geography taking equal place with historical geography. As is shown in Fig. 4 papers on travel and exploration were still common, but they virtually died by 1927.

Two significant resolutions passed by the Congress which later left their marks on the pages of the Bulletin were : A. Demangeon's proposal for a commission to study the form of rural settlement (with a questionnaire and the central collection of replies), and the decision regarding the necessity of an international geographical bibliography. In 1927 the Bulletin undertook a general survey of rural settlement in Egypt, and a special questionnaire, prepared by J. Lozach, was published in vol. XV. The enquiry was made in both arabic and french. Lozach, working on lines suggested by Demangeon, initiated this with a paper on « *Enquête sur l'habitat rural en Egypte* » (vol. XV, 115-124). The work was taken up for Upper Egypt by G. Hug, and the whole survey was completed in the following 3 years [1].

The value of compiling a geographical bibliography of Egypt within the pages of the Bulletin was discussed early in 1920, and the work was largely undertaken by H. Gauthier and H. Munier. Gauthier, whose work on the « Bulletin bibliographique » was mentioned earlier, initiated

[1] J. Lozach et G. Hug, *L'habitat rural en Egypte*. Préface par M.A. Demangeon. Le Caire 1930.

in vol. XIV, 1925 a '*Bibliographie géographique de l'Egypte*'. For a period of 9 years he wrote currently in all volumes of the Bulletin until 1933. From 1934 the work was faithfully continued by H. Munier for another 9 years period until 1942. Thus for almost 20 years, from vol. XIV to vol. XXI, the Bulletin has devoted an average of 22 pages in each volume to the compilation of a geographical bibliography of Egypt. It is a most regrettable fact that the Bulletin ceased to take positive interest in compiling the bibliography after 1942. The sudden death of Munier in that year, the war conditions at the time and the change of responsible staff (the president and the general secretary) of the Society partly explain the lack of interest to maintain and to keep up the bibliographical efforts of the pre-war period.

The second and most important event in 1925 was the official establishment of the Egyptian University in Cairo. As early as 1908, however, Geography was taught in conjunction with History at the 'Arts Faculty' of the only existing 'National University' at that time. French scholars and french-educated Egyptians, who were the first to be charged with the teaching of geography, seem to have laid stress on history, and considered geography as an integral part of the general field of history, or at least as a closely allied subject. Not unlike the position in France at the beginning of the century, geography lectures were given either by historians, or were devised as subordinate to the teaching of history [1]. Even to-day the weight of tradition makes the complete separation rather undesirable. Thus the orientation in training was definitely towards the historical approach, and historical geography featured vigorously and intensively in all volumes of the Bulletin between 1925 until the end of the 2nd World War. With the establishment of a new chair in geography in 1925 more weight was given to the element of time in the subject, and the relations of history and geography — of long standing — became closer than ever before. Out of 8 papers published in vol. XVI (1928) 4 were devoted to historical geography. Vol. XVII contained 17 papers, 11 of which were on the historical geography of Egypt.

[1] R.J. Harrison Church, « The French School of Geography » in *Geography in the Twentieth Century*, edit. by G. Taylor, London 1953, p. 71.

Throughout the whole period from 1925 to the end of the 2nd World War more than 40% of all articles published in the Bulletin were written on historical geography, being 37 out of a total of 90 while only 5.5% were devoted to physical geography.

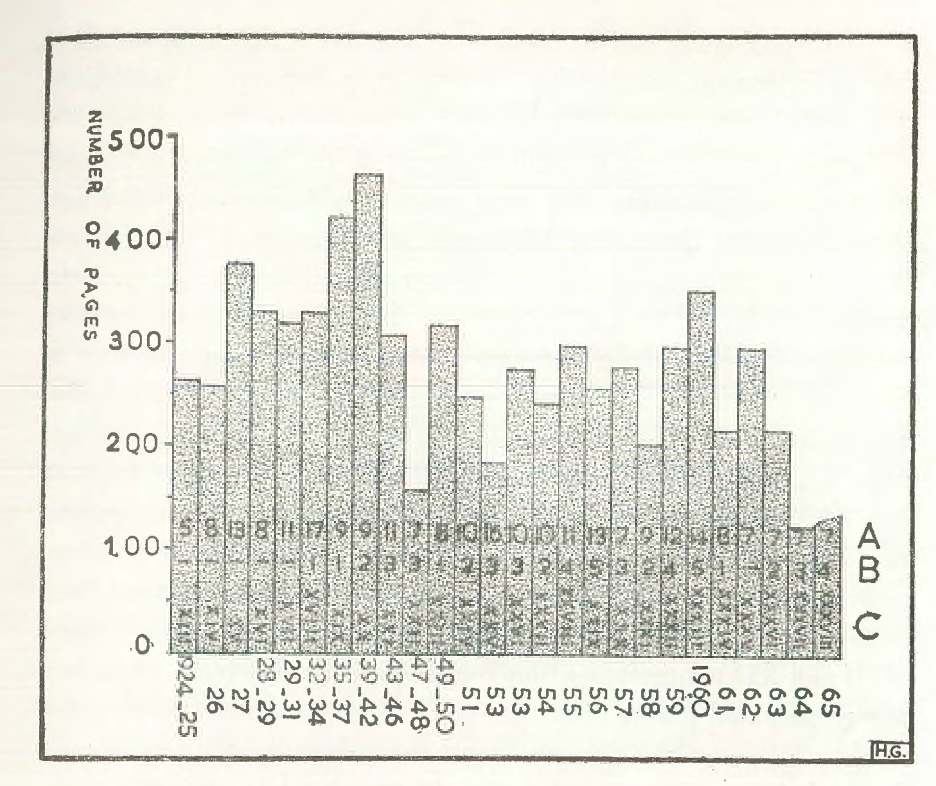
The second largest group of papers published in the Bulletin during that period was that concerned with the non-geographical, being 27 papers out of a total of 90, i.e. approximately 30%. These were mainly a continuation of the disproportionate bias towards ethnology referred to earlier. Although the great majority of the non-geographical papers here were those on ethnology, anthropology, archaeology and history, some were on geology, palaeontology and even chemistry.

In general this period has seen the development of geography along lines which were pretty clearly indicated in the 1920's, but generally in more favourable conditions, partly due to the wider recognition accorded to the subject, and more simply to the fact that more trained geographers were engaged in research.

A feature of the 1930's was the slow but steady contribution of papers to the Bulletin by professional Arab geographers. Fig. 2 includes the number of articles written by Egyptian geographers in each volume. M. Amer, S. Huzayyin, M. Mitwally and A. Ammar were the pioneers, so to speak, in an almost entirely foreign ground. They delivered papers in English and Arabic, some with respect to work which they already undertook for their research degrees abroad, but almost all were in some way or another related to historical geography. A further commentary on the Egyptian contribution will be treated later in this review, but it is worth while mentioning here that apart from Amer's two papers in vol. XVIII and vol. XIX, the Bulletin had to wait almost 70 years before it could publish works by professional Egyptian geographers. It was during and after the 2nd World War that the Bulletin began to be used as a publishing medium of research done by the Arab geographers.

The Post-War Period, 1945-1965

The contents of volume XXII indicate the direction in which the Bulletin was to advance. There were 7 papers, 5 on geomorphology, only one on historical geography, and another on economic geography. Three



(A) Total number of papers.
(B) Number of papers written by Egyptian Geographers.
(C) Number of volumes.

Fig. 2.—Volumes of the *Bulletin de la Société de Géographie d'Egypte,* 1925-1965.

out of the total number of articles were written by professional Egyptian geographers. Non-geographical papers did not exist. This is not a typical volume of the period, rather it is simply a reflection of the considerable changes that took place in the Bulletin after the War.

Geomorphology grew almost suddenly in 1947 and continued to take a prominent place in the Bulletin until 1959. This was roughly the period when Prof. H. Awad — a geomorphologist — was General Secretary of the Society and Editor of its Bulletin. He himself contributed three papers in that volume. The growing number of Egyptian geographers was not accompanied by a proportionate increase in the number

of geomorphologists, and H. Awad — as editor of the Bulletin — had to rely mainly on the contributions of Egyptian geologists and the foreign geomorphologists.

However, the tendency to eliminate or play down the subject of physical geography, of which there was some evidence in the pre-war period, had been thoroughly checked by 1947. On the other hand, the tendency to exaggerate the size of historical geography which characterized the previous period had been considerably limited. Only 15% of all articles published in the Bulletin between 1947 and 1959 were devoted to historical geography, while more than 38% were given to physical geography. This stood in sharp contrast to the position before the war when historical geography between 1925-1945 had a percentage of over 40%, while physical geography barely attained 6%. Non-geographical papers have received much the same fate as that of historical geography. They dropped suddenly after the war to an average of one or two papers in each volume until 1960, and there were two volumes (XXII and XXX) entirely free from contributions by outsiders. Unlike the non-geographical papers of the pre-war period which were closely allied to historical geography, i.e. ethnology, archaeology and anthropology — those of the post-war period were, closely related to geomorphology, i.e. geology, hydrology and soil sciences.

From 1960, however, physical geography, particularly geomorphology could no longer maintain its vigorous percentage. In the last six volumes of the Bulletin, there were only 7 papers on geomorphology out of a total number of 51, i.e. a percentage of less than 15%. Non-geographical papers have increased once more from a minimum of 15% between the last World War and 1959, to almost 40% since 1960. On the other hand a more varied representation of the various branches of geography has become a characteristic feature of the Bulletin since 1960. M.S. Abo-El-Ezz was the editor for one year in 1960, until M.M. El-Sayyad took over since then. The essentially geomorphic character of the Bulletin since the war came to an end when H. Awad left for the Maghreb in 1960. During the last 5 years relations between professional geographers in this country and the organization of the society and its Bulletin have become closer than ever before. In 1965 only one of the 12 members of the central committee (conseil d'administration) was not a professional geographer. In 1953 for example there were only 5 geographers on the board of staff, 4 of whom were no longer practising geographers. In terms of research output 72% of all papers published in the last 6 volumes, were written by Arab scientists (geographers and non-geographers). The rest, being 28%, constitute the foreign contribution, half of which is non-geographical. The percentage of papers written by professional Egyptian geographers in the last five volumes is not much different from that of the previous period. Indeed one volume (XXXV in 1962) has none at all.

The last forty years of the Bulletin surveyed here have seen the development of a more geographical approach, the growth of an organized body of geographical literature, the emergence of a larger number of trained Arab geographers and a recognition of the role which the Bulletin can play in geographical research and the dissemination of scientific knowledge at large. It is perhaps worthwhile, at this stage, to examine more closely the research output of the Bulletin during the last forty years from the following points of view : (*a*) subjects covered, (*b*) regional coverage, (*c*) the contribution of Egyptian geographers, (*d*) book reviews, and (*e*) maps.

(a) Subjects covered by the Bulletin.

Figure 4 summarizes the contents of each volume of the Bulletin since 1925. All papers have been classified into one or another of 9 groups shown in the diagram : non-geographical papers, travel, geomorphology, social geography (including population and settlement), biogeography, economic geography, climatology, historical geography, and others (mainly geographical). The classification is, of course, highly arbitrary, since only one label is given to each paper, and some papers may contain material relevant to two or more groups. One is forced to use his own discretion. However, the analysis shows that the largest group is that concerned with the non-geographical papers 68, followed by historical geography 60, geomorphology 44, economic geography 24, social geography 20, and then biogeography and climatology 8 each.

Although no specified branches of geography are officially favoured by the Bulletin yet some disproportionate emphasis on historical geography is maintained all through. Out of a total of 255 papers published in the Bulletin during the last forty years, the second largest group is that concerned with historical geography (60), (non-geographical papers forming the largest (68)). The breadth of interest in historical geography, however, is not greatly varied in scope. Egyptian prehistory is perhaps the most characteristic of the historical studies, but some on ancient Egypt and medieval times, especially of early travellers are also published. Among the valuable studies are those of G. Daressy on the Nile branches during the 18th dynasty (vol. XVI, XVII and XVIII), S.A. Huzayyin on the beginnings of Egyptian civilization (XX, 203-273) and the origins of neolithic and settled life in Egypt (XXIII, 175-181), L.P. Kirwan on the Ballana civilization of Lower Nubia (XXV, 103-110), M. Awad on the diffusion of Arab influences in the Sudan (though largely ethnological, vol. XXV, 111-135), M. Clerget on medieval Arab towns (XVIII, 1-8), Et. Combe on Alexandria since the Arab conquest (XVI, 111-171 and 269-292), and P.H. Dopp's four papers on medieval Cairo (XXIII, 117-149, XXIV, 115-162, XXVI, 87-118 and XXVII, 5-49). Almost nothing is written on the changing pattern of rural settlement, of land use and agriculture. So great have been the detailed works on Egypt's pre-history and ancient history that the subject of historical geography to many has become almost synonymous with pre-history, together with ethnology, archaeology, and physical anthropology. Historical geography in the sense of the geography (both physical and human) of historical periods, i.e. the reconstruction of the geography of a past period is not particularly developed in Egyptian research publications, instead, it has been essentially human geography in its evolutionary aspects.

The dominance of papers on historical geography before the 2nd World War has already been noted. Nearly half the number of Egyptian geographers who contributed to the Bulletin are specialists in that field. Historical geography received its greatest attention in the 1930's and early 1940's when the average number of papers/volume reached 60%. In the pre-war period (1925-1945) more than 40% of all the

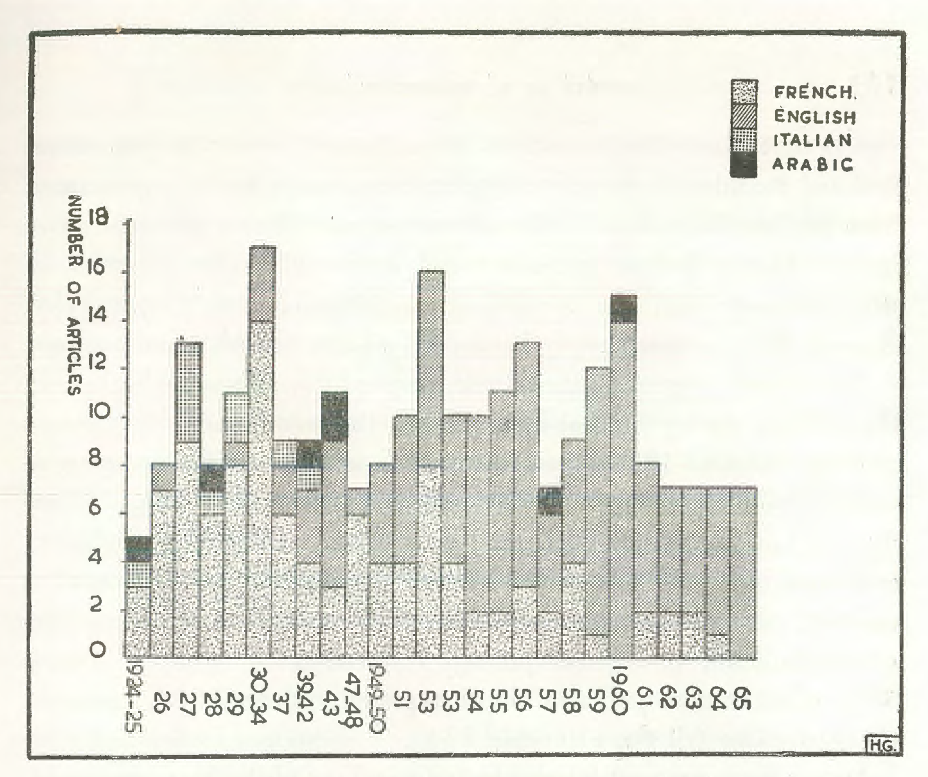


Fig. 3. — Language distribution of papers in the *Bulletin de la Société de Géographie d'Egypte,* 1925-1965.

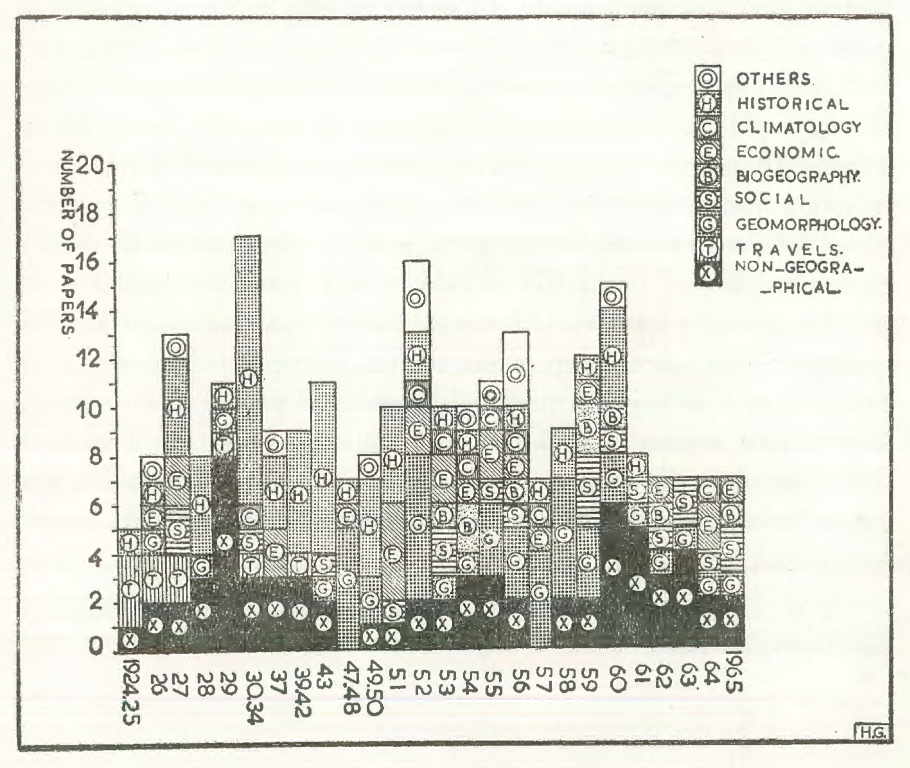


Fig. 4. — Contents of the *Bulletin de la Société de Géographie d'Egypte,* 1925-1965.

papers were devoted to this subject. After the war however, the percentage declined considerably to only 15% and even to its total disappearance from the last five volumes. The dominance of historical geography had been definitely broken and the trend developed in the direction of geomorphology and the specialized branches of human geography. Reasons for this have already been dealt with in the historical analysis.

The second largest group of the geographical papers published in the Bulletin during the last forty years is that concerned with geomorphology. Out of 187 papers (being 255 total minus 68 non-geographical), geomorphology numbered 44, being less than 25%. Total figures, however, do not tell the whole story. Only 4 papers were published in the 20 year period before the end of the war. It was after the war, particularly the period 1947-1959 when H. Awad was editor of the Bulletin, that geomorphology featured more strongly, making 38% of all papers published in that period. From 1960, however, the percentage fell down to only 15%.

Among the areas particularly studied are those of the Sinai peninsula, the Egyptian Deserts, the Nile Basin and parts of the Arab World, especially Iraq and the Levant. In nearly all articles special interest is given to hydrological problems. Coastal investigations have been mainly carried out by geologists interested in the studies of land forms. Perhaps the most prolific writers on the subject are G. Hug, H. Awad, Et. de Vaumas (8 papers each) and J. Cuvillier (6). Eminent foreign contributions include two papers by Emm. de Martonne and one by A. Desio. The chief contribution by Egyptian geomorphologists include H. Awad's papers on Central Sinai, Gilf el-Kabir, the Levant, the Lake Plateau and his general papers on arid zones, deserts and piedmonts. Y. Abo-el-Haggag contributed 4 papers, one on N.E. Ethiopia, the other on N.E. Iraq and two on Najd. A substantial number of papers on the subject, however, are written by Arab geologists and those of the allied sciences.

In analysing the post-war contributions to the '*Transactions and Papers*' of the Institute of British Geographers, Professor R.W. Steel [1]

[1] R.W. Steel, «A Review of I.B.G. Publications, 1946-1960». Transactions and Papers, *The Institute of British Geographers,* 1961, *Publication* No. 29, p. 137.

found that the second largest group was that concerned with economic geography. In the Bulletin, only 24 papers, out of 255, are devoted to the subject, i.e. a proportion of less than 10%. The development of economic geography in the Bulletin is extremely erratic in nature. There are no marked periods of interest or disinterest in the subject. Many volumes contain no papers on economic geography at all, and only a few have more than one. However, the subject seems to be a feature of the post-war period, since only 4 papers were published between 1925 and 1945. In recent years more weight is given to economic geography, especially since 1961 when M.M. El-Sayyad became editor of the Bulletin.

Linked with the home questions, papers on economic geography have concentrated on water and irrigation problems. Out of 24 papers 13 have dealt with irrigation, a percentage of almost 60%. Recurrent high and low floods and shortages of water in marginal areas have provoked many geographers to pay attention to these problems. There were three papers on the High Dam alone, 12 on agriculture and land use, but only one on industrial geography, two on transportation and one on methodology. Nearly two-thirds of the number of contributors were Egyptians. Although the main interest is in the home country some papers dealt with parts of the Arab World (especially Iraq, the Sudan and the Maghreb), while two were written on the U.S.A.

Not unlike economic geography, the sociological aspects of geography (namely population studies and rural and urban settlements) in the Bulletin are also a feature of the post-war period. Only 4, out of 20 papers on social geography, were published before the war. During the last 7 years and since the drop in number of papers on geomorphology in 1959, social geography featured regularly every year, with at least one paper in each volume. A few of the directions in which research has developed may be noted here. Population and urban studies have received the greatest attention, being 47% and 42% successively of all papers on social geography. The pre-war interest in the rural survey of Egypt — mentioned earlier — is no longer maintained. Only one paper in the post-war period dealt with rural settlement. With one or two exceptions all papers on social geography dealt with Egypt and/or

parts of the Arab World. Among the early studies on population in Egypt was A. Breccia's « *Lo stato della popolazione dell'Egitto dalla schiavitù di ieri alla libertà di oggi* » (XV, 77-83). Further detailed studies have been contributed by M. Mitwally. « *The population of the Egyptian Oases* » (XXI, 109-138 and 289-312). E. de Vaumas wrote a long article on « *La répartition de la population au Liban* » (XXVI, 5-76). The study of social groups and bedouin life has received an increasing attention in recent years. Among the contributions made were those of M. Awad on the Northern Sudan (XXXVII), S.D. Misra on Himachal Pradesh (XXXV, 217-272) and Y. Toni on Cyrenaican Libya (XXXVI, 113-136).

A large number of contributions to urban geography have been made. As early as 1934 M. Clerget wrote on the common and distinctive characters of Arab towns (XVIII, 1-8). Of the recent studies, however, mention must be made to D. Sadek's two papers on Cairo and Damascus (XXVIII, 93-98 and XXIX 139-144), J.H.G. Lebon on Baghdad (XXIX, 7-32), M. Abo-el-Ezz on the migration aspects of Cairo (XXXII, 121-142), G. Hamdan on Khartoum (XXXII, 89-120) and T. Abo-el-Ela on Riad (XXXVIII). On the whole urban studies like population studies, have been mainly concerned with the home problems and those of the neighbouring Arab World. Only one article dealt with towns outside these regions.

More than any other branch of geography it is in the field of social and cultural geography that the old topic of geographical determinism threatened from time to time to become involved in the Bulletin. In recent years, however much care has been taken to avoid the broad generalizations characterizing the pre-war period. Elliot Smith's hypotheses have received critical treatment, so have the geographical theories on the origin of Egyptian civilization. Very few still accept as of value the diffusion of culture and parallel evolution in different areas.

Climatology and Biogeography each has the same very low percentage of papers published in the Bulletin during the last forty years. In the pre-war period only one paper on climatology appeared in vol. XVIII, while in the general field of biogeography nothing has been published before 1953. Thus, the development of two subjects must be considered

in the light of their very recent growth. At least one paper, in either fields, is published almost regularly in every volume since 1952. Papers marked B in the diagram, indicating biogeography, are all written by botanists interested in plant ecology and phytogeography. It would be unprofitable to summarize in detail the whole research output on the subject, but mention should be made to M. Kassas's four papers on the ecology and plant cover of the Egyptian and Sudanese deserts, A.M. Migahid's (and others) on Sinai, Kharga and Dakhla oases, and A.H. Montasir's two papers on the environmental factors of plant distribution in Egypt (XXVII, 115-143).

If the scope of studies undertaken in biogeography is fairly regional, papers dealing with climate and micro-climate show a great variety of interest. Out of 8 papers on the subject three were written on Egypt, two on the Nile Basin, one on the British Isles, another on Iran, and one on climatic changes in N.W. Europe. Facts of authorship include two Egyptian geographers (M.B. Hefny and A.T. Sharaf), one meteorologist (M.G. Elfandy), a plant ecologist (M. Kassas) and three foreign climatologists (M.V. Frolow, M.H. Ganji and T.L. Bryant).

Probably the most embarrassing fact of professional interest about the contents of the Bulletin is the large proportion of non-geographical papers. These are found to be the largest group in the classification of subjects, being 68 papers out of a total of 255, i.e. more than 26%. For the pre-war period some justification may be found in the fact that the number of professional geographers was very small. The Bulletin, therefore, had to supplement its otherwise smaller volumes by publishing material loosley related to geography. Furthermore the Society and its Bulletin were not yet crystallized on a professional basis, rather they mainly catered for the ' intellectual '. The Society was one of ' Geography' not of ' geographers '. In the post-war period, however, the same justifications can hardly be true since the number of professional geographers has largely increased. True, the proportion of non-geographical papers was lowered to only 15% during the post-war period until 1960, but the average seems to be rising once more, and the exodus which some expected has not occurred. Of the 51 papers published since 1960, 20 are not geographical, i.e. almost 40% which is a much higher

percentage than the average for the whole period since 1925. This is a rather serious problem, and the younger generation of geographers in particular resent this trend. It is perhaps true that almost all editors of the Bulletin were quite favourable to the advance of geography through publishing material written by those in the other sciences. However, the real reason seems to lie in the geographers themselves. With the expansion of university departments of geography in recent times Egyptian geographers have become so overburdened with teaching responsibilities that little time — if time at all — is left for research. Moreover many — especially of the older generation — had to abandon geography for the more profitable positions in administration and the Government, here and abroad.

Three general comments may be made on this group of non-geographical papers. The first is concerned with the nature of different sciences involved. In the pre-war period the humanities, as represented by history, archaeology, ethnology and anthropology, were more dominant in the non-geographical group than the physical sciences. Reference to this fact has already been noted in the historical review. In the post-war period, however, the non-geographical papers were mainly on geology, biology, pedology, palaeontology, and water engineering. That this was so was due largely to the influence of H. Awad, Secretary of the Society from 1946 to 1959.

The second comment arises from the different approaches adopted by those of the physical sciences when writing in a geographical magazine. Of the papers written by botanists a great number deals with ecology, vegetation, climatic influences and many other aspects which often rub shoulders with plant geography. In fact most of these were treated as geographical papers in our classification. Meanwhile, papers written by the geologists are rarely geographical or geomorphological. Some are entirely in the fields of palaeontology, stratigraphy, structural geology and even minerology. Mostly they are of immediate local interest to the geologist rather than to the geographer or the geomorphologist.

Thirdly reference should be made to the fact that while geographical papers may have dealt with regions for outside Egypt, non-geographical papers have almost all been concerned with topics of local and regional

interest. The great majority of contributions came from Egyptian scientists, though some foreign scholars were particularly abundant in the pre-war period.

However, many geographers feel disturbed at the neglect of a more geographical approach to their particular subjects in the Bulletin. It is not that Arab geographers want to monopolize the Bulletin, rather they wish to see its contents more geographical. Thus geomorphological and biogeographical papers written by geologists and botanists are definitely welcomed. On the other hand, sheer geology or history and archaeology looks quite undesirable in a geographical periodical. If we have dealt on this point at some length it is because we feel that some effort must be done in order to safeguard the Bulletin against my drifting.

(b) Regional Coverage.

Although, nominally at least, the Bulletin accepts the entire realm of geography as its field, yet it practically limits itself to Egypt, Africa and the Arab World. However, considerable changes have taken place in the regional emphasis, especially in recent times; and before we attempt an analysis of the regional coverage since 1925, it is perhaps worthwhile comparing the general interests of the Society in particular areas during the first half-century of the Bulletin with that of the second period. The following table shows the regional distribution of papers published in the Bulletin since 1875, expressed in percentages :—

REGION	THE FIRST PERIOD 1875-1925	THE SECOND PERIOD 1925-1965
	%	%
Egypt	48.6	70.5
The Arab World (excl. Egypt)	14.7 (more than 2/3 on the Sudan).	20.0
Africa (excl. the Arab World)	24.0	2.7
Asia (do)	5.0	1.0
Europe	1.0	1.2
Americas	1.0	1.2
Australia	0.32	—
Polar Regions	0.32	—

Regional Percentage of papers in the Bulletin (1875-1965).

Very little is now written about Africa if compared to the earlier period. Of all papers published in the Bulletin during the last forty years only 2.7% were devoted to Africa (excluding Egypt and the Arab World), while 24% of the total number of papers published in the first half-century were devoted to that continent. This last percentage does not include a further 11% on the Sudan alone. The part played by the Society and the Bulletin in African exploration, particularly in the first quarter-century of their history, has already been noted (see p. 84-85). Attention was directed mainly to East and Central Africa and for the most part the contents were in the nature of exploratory research. A small number of papers on West Africa appeared in the first three volumes. It is interesting to note that since 1893 no more papers about West Africa were ever published in the Bulletin until after the mid-twentieth century, when two articles by French geographers appeared in vol. XXV in 1953. A regional distribution of papers dealing with Africa in the last forty years of the Bulletin is almost meaningless since the number of these papers or their percentage to the total is too small to permit analysis.

Meanwhile, a remarkable increase of interest in the Arab World took place in the second period. The 14.7% of the first fifty years is a misleading percentage since more than two-thirds of these papers dealt with explorations and discoveries in the Sudan. Thus, excluding Egypt and the Sudan, the percentage of papers on the Arab World during the first period would come down to only 3.7%. Of the 57 papers published in the second period, however, 10 are general papers treating the Arab World as a whole, 14 on the Levant, 8 on the Sudan, another 8 on the Arabian Peninsula, 7 on the Maghreb Countries, 7 on Iraq and 3 on Libya. The greater number of these papers are written by Egyptian geographers, and many are actually the result of university expansion in different parts of the Arab World.

Papers dealing with Egypt, the home country, have risen from 48.7% in the first period to more than 70% during the last forty years. Reasons for this are not difficult to seek. The Bulletin has come to what may be called a new era — a period of increased interest in the home country and the greater homeland of the Arabs, a new and different outlook on Africa south of the Sahara, and an increasing number of Egyptian

geographers. Furthermore, the Bulletin has also come to what may be called a new function — a publishing medium of research carried out by the Arab geographers of the U.A.R. who can best maintain contact with their own country. The sparce distribution of interests outside Egypt revealed by the table reflects the limited opportunities for travel and residence abroad.

(c) The Contribution of Egyptian Geographers.

Of the 255 papers published in the Bulletin between 1925 and 1965, only 54 were written by professional Arab Geographers, i.e. a percentage of less than 24%. They are all members of the academic or administrative staffs of universities in Egypt and their extensions in other parts of the Arab World. The remaining 76% represents articles written by foreign geographers and non-geographers from Egypt or abroad. Recently, however, very few foreign geographers still send their papers to the Bulletin.

The relatively low number of articles written by the Egyptian Geographers in the Bulletin reflects their own limited size. All in all, qualified geographers in this country are slightly more than 50, including demonstrators and assistants. But, what is more important, is the fact that the Bulletin, perhaps; still abides with the 1956 statuate, encouraging the publication of « *allied sciences*». It is also a fact, lamented by some, that for the most part of the Society's history, geographers in the Egyptian Universities have played a relatively minor role in producing its Bulletin. Active participation started only after the 2nd World War, when Professor H. Awad became Secretary General of the Society and editor of the Bulletin. Figure 2 shows how small is the number of articles written by Egyptian Geographers compared to the total number of papers in each volume.

However, in view of the Society's history this is not as surprising as it may seem. Academic geography in Egypt is much younger in age, while the Society and its Bulletin are nearly half a century older.

The following map (Fig. 5) takes account of the 54 papers written by professional Arab geographers from the U.A.R. and published by the Bulletin.

Only three papers dealt with areas outside Africa and the Arab World. The rest were mainly about Egypt (25), the Arab World (19) and Africa (6). It is not unnatural to lay disproportionate emphasis on the home country, the greater homeland and the continental hinterland, with which the contributors can best maintain contact. The three papers concerned with Europe and N. America are to some extent the result of field work carried out by the authors when studing for higher degrees in Britain and the United States.

The relatively low number of papers written by U.A.R. geographers and presented to the Bulletin must not be taken as an indication of their low research output. Many papers rightly appear in the Annals of each of the Egyptian Universities and some in foreign Journals. Undoubtedly, in terms of research accomplished and published in a year, the productive ability of a university department of geography exceeds that of the Society's Bulletin.

Of all branches of Geography, it is in Historical Geography that Egyptians have made their greatest contribution. A breakdown of the 54 papers by subjects gives historical geography 16, followed by social geography 13, geomorphology 12, economic geography 7, climatology 5, political geography and regional planning one each. However, the preponderance of papers on historical geography in actually the lot of the older generation of geographers. Present day development of the subject is strongly oriented towards social geography and geomorphology.

It is of some interest to note that of the 54 papers written by professional Arab Geographers 21 came from the Department of Cairo University, 20 from Ain Shams, 10 from Alexandria, one from Assiyout [1] and another from Al-Azhar. The almost equal numbers of the Cairo and Ain Shams Departments raises some astonishment in terms of the history of Geography in the two universities. Cairo University is 25 years older than Ain Shams. Young and vigorous, however, Ain Shams University has more geographers than any other Egyptian University, and in fact

[1] The University of Assiyout has not yet established a Department of Geography, and the one paper mentioned here came from Professor S.A. Huzayyin when he was rector of the Univ. in 1956.

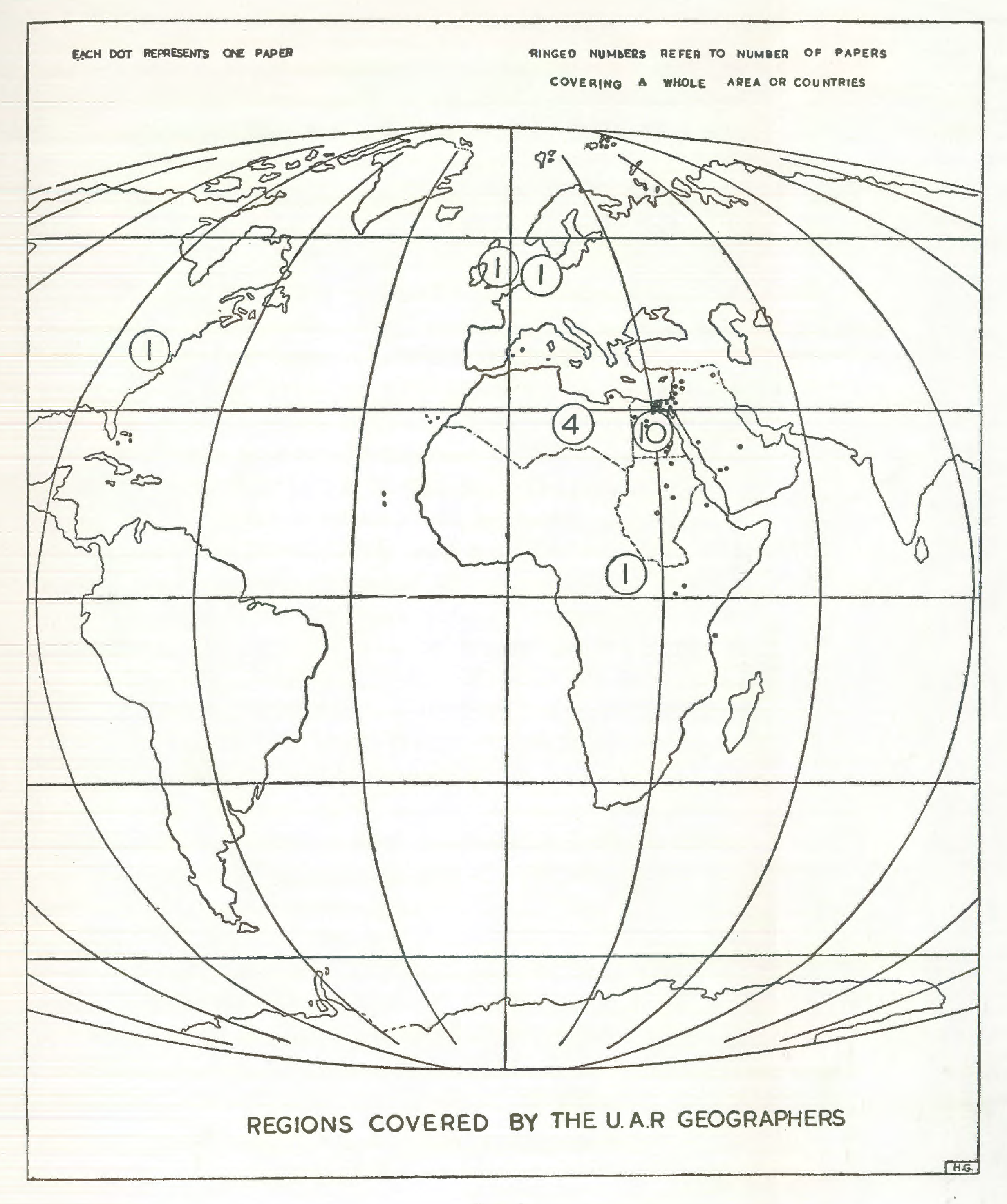


Fig. 5.

has more than one Department of Geography. Nevertheless, a substantial number of the Ain Shams papers came from one prolific writer, Prof. H. Awad, who also happened to be the Editor of the Bulletin from 1947 to 1959 [1].

With one or two exceptions, only geographers who have done post-graduate work abroad contributed papers to the Bulletin. Still in the heat and fire of research and before being overburdened with teaching responsibilities in Arabic, they presented papers dealing with one aspect or another of their favourite research areas. In some cases the paper is actually part of the thesis submitted to the foreign University. In others it is a development of one aspect briefly discussed in the thesis, or a study based on already accumulated material during the original field work. There is neither the time nor the financial possibility of conducting another field work in another Area. The contributor is also understandably keen to establish his identity and his field of specialization in the pages of the Bulletin. Only later, very often much later, when teaching hours are less and financial difficulties for field work are reasonably solved, is one able to write about a new subject or a new research area. Thus S.A. Huzayyin, M. Mitwalli and M.E.S. Ghallab — to mention only a few as an example — who made their debut in the Bulletin as early as 1939, 1943, and 1951 respectively, did not appear again in the Bulletin until 1949, 1950 and 1958 in the same order. This does not imply that the time between the first and the second paper was completely swallowed up by teaching duties, for many become engaged in writing much needed text-books in Arabic and some undertake research of an arm-chair type of work, while others may contribute to other scientific journals.

It may seem unnatural that Arab Geographers should write their papers in a foreign language. They do so, however, because they wish their work known and criticized in the West. The Bulletin, by virtue of its international reputation and wider circulation, provides a convenient medium of publication for the Arab Geographers.

---

[1] Vol. XXII of the Bulletin contained 7 papers, three of which were written by H. Awad.

(d) Book Reviews.

Research is constantly and ceaselessly discovering new facts and developing new ideas. Appraisal of the new literature in geography ought to have been a necessity in the one and only geographical periodical in the Arab World. The number of reviews published in the Bulletin throughout its long history is merely 21. Three appeared in the first fifty years, and of the remaining 18 published since 1925, 6 were written by H. Awad and 4 by W.F. Hume. No reviews were ever published in the Bulletin since vol. XXIII in 1950. This is indeed a very serious shortcoming. The Society cannot really fulfil its function without keeping abreast of current progress in geographical research, and the Bulletin seems to be the logical place for reviewing new literature.

Since 1961, however, a list of new additions to the library of the Society appeared currently in each volume. Helpful though it may seem, the reader finds no comments, no assessment and no evaluation of the newly acquired literature. Vol. XXII and XXIII also included the new aquisitions between 1946 and 1949. This practice was not resumed until vol. XXXIV in 1961.

(e) Maps.

Finally a critical word about maps and map production. In terms of quantity the amount of cartography in the pre-1925 volumes was very small. The average number of maps per volume was only 4, and some volumes contained no maps at all (vol. X in 1921 and vol. XII in 1923). This stands in sharp contrast to the position after 1925, especially after the 2nd World War, when the average number of maps per volume reached 17, and some volumes had as much as 38 (XXVIII, 1955) and 39 (XXXIII, 1960) maps.

Many maps of the first fifty years tell the story of exploration and discoveries in Africa. Reference has already been made to the cartographic achievements of the Egyptian officers and their American colleagues in Somaliland and East Africa. Important contributions also came from such illustrations names like Rohlfs, Jordan, Linant de Bellefonds, Heuglin, General Gordon, Colonel Mason and Dr. Junker. This was the time when the Bulletin catered mainly for explorers and pioneers in hitherto unknown areas.

The general standard of maps after 1925 was not perhaps as high as it should have been. Skilled, full time draughtsman and map compilers are not appointed in the Society. University departments of geography have no access to prefessional draughtsmanship. The contributor, therefore, cannot rely, for some of his work, on assistance of this kind from the Society or from his Department. Many geographers make use of their graduate — and even undergraduate — students for assistance in map-drawing, but the work is generally unskilled.

For the first time since the 1920's, vol. XXXVII in 1964 came out with only 5 maps, a figure much below the average for the whole period since 1925 (17), and hardly comparable to the one preceding it (22) in 1963. This is perhaps tied to questions of expense in addition to the technical problems of draughtsmanship mentioned above. Rich though the Society may be, it had some difficulties of cash money in recent years. However in many instances a large amount of space is taken up by maps which are quite unnecessarily large. It is much easier to cut costs by reducing the area of a map than to persuade an author to cut down the number of his words. Furthermore, quite a number of maps in the last ten volumes are printed using pull-out folding pages, though the shape and detail of the drawing does not really justify the relatively high costs involved.

Of all contributors, geographers not unnaturaly — have been particularly prolific in offering a substantial number of maps and photographs to illustrate clearly their papers.

III. — CONCLUSION.

The academic and educational influence of the Bulletin cannot be estimated in terms of the number of copies issued every year or the number of members enrolled in the Society. What really matters is how students, teachers and members of the academic staff make use of what they learn thereby, and how much is gained in return for the annual subscription paid by the members of the Society.

Undoubtedly the level of geographical knowledge in this country — low as it may be — would stand even lower if the Bulletin did not exist. An original paper or map published in one of its volumes may start a ferment of thought in the minds of its readers. The publication of newly acquired geographical material is of immense value to the geographer, at home and abroad, whose interests lie, partly or wholly, within the confines of the Arab World.

Geographically, the U.A.R. has arrived — for good or ill — at a position of leadership among the Arab countries. It is beside the point to argue here as to how we arrived at that position, whether that leadership was sought or unwanted and whether it found us prepared or unprepared for the task. Egyptian geographers find themselves on the spot; they cannot decline, they can only succeed or fail. Success can come only if they understand and assist in the solution of problems which lie outside their own domestic area.

This would seem to mean that in the future unlike the past, it will be fundamental that Arab geographers in general, and U.A.R. geographers in particular, be informed much more adequately about our own world, the Arab World — its people, their social institutions, their economics, their natural resources, their history, their relations, their problems, in short the co-variant factors of place, people and history as how arranged in dynamic equilibrium. The Bulletin is and, no doubt, will continue to be one of the better mediums for publishing all kinds of geographical research relevant to the Arab World. Furthermore, the Society, to which the Bulletin belongs, remains and will continue to remain one of the most important centres in the World of available documentary, map, library and statistical facilities for research in almost all parts of the Arab World.

GEOGRAPHY AND TOWN PLANNING

BY

D[R] YOUSRY EL GOWHARY

The aim of this paper is to discuss the geographical aspects of town planning and to show some of the contributions of the Egyptian geographers in this field. It is also to illustrate how cities are living creatures (1), which must be planned and controlled and to be controlled, must be understood on geographical bases.

PLANNING AND GEOGRAPHY

The word planning means the efforts which take place in any environment in the field of education, health, economics and town planning in order to provide the inhabitants with sufficient social services and public utilities. Geography is the subject of distribution. It seeks to understand the relationship between man and his environment and to interpret this relation in both time and space. Here the geographical problem in its essential essence is how and why does one part of the earth's surface differ from another (2) and what is the main human feature in the land use pattern. This statement reveals that geography is pre-eminently the liaison science, and in the field of town planning the geographer joins forces with the architect and engineer. However, in question of site and approach, and the relation to environment generally, the problem of town planning belong equally to the field of geography (3). It is well known to the geographers and planners that the appearance of any city depends upon its site (4), and each agglomeration has its individual character which must be included in any attempt to develop or redevelop the city in the direction of its wealth or its spiritual expression (5). Thus the geographer shares the planner the responsibility of choosing the suitable locations for various activities because the main aim of planning at the present time is to enable all

activities to take place under the best practicable condition in suitable location. The fulfilment of this aim requires that buildings with similar siting requirements should be grouped together and conversely that in general, buildings with different functions and conflicting siting requirements should not be grouped together (6). This means that the different uses in any city must be distributed in distinctive segments, of which each zone should be designed to provide suitable sites for various kinds of utilization. So it is a matter of great interest as geographers to discuss the suitable and unsuitable locations of the different activities in any urban agglomeration in order to assist the planning authorities and all those concerned with the city growth in determining the suitable location for both the development and redevelopment trends.

Housing Location :

The main factors which determines the selection of residential areas are proximity to schools and open spaces as well as the freedom from the dangers of heavy traffic on the highway and the main roads (7). The desirable location for new satellite districts can be delineated in two ways. As regards population, a site can be selected where there is a little concentration of population (8) or the site can be chosen where the main increase of population occurs. The later method, from the point of view, is preferable to the Egyptian cities than the former because most of the attractive segments for the inhabitants deconcentration are located within the outer districts. In contrast with these areas are the central areas which have unsuitable housing location as well as a little increase of population (9).

It should be mentioned that housing in its widest sense as average human environment is bound to be one of the pivotal questions of the twentieth century (5). Because of terrible congestion of population cities, it is a point which claimed the attention of scholars as never before (10). The urban population of Egypt is not static but it is constantly increasing, and as population increases the congestion affects the sub-total of specific age groups, occupational distribution and also the distribution of densities. Naturally, all the above mentioned

considerations must affect the total number of houses needed to satisfy the future requirement of residential, commercial, industrial and institutional accommodation (11).

From the demographic point of view, there are two factors which should be taken into account in any attempt to estimate the present housing needs.

First is the change in total population do not necessarily mean corresponding changes in the number of biological families (12). In other words the growth of population during a certain period may be due to the increase of birth rate so that the whole growth would be absorbed by a large family size with a slight increase in the number of families which need houses. This phenomenon appears clearly in the provincial cities of Egypt during the period between 1947 and 1960 when the population growth has depended primarily upon the natural increase and mortality; imigration has been relativally unimportant. The second important demographic factor is « the demand for houses and other dwellings does not really come from the biological families, but from actual and potential household». This means that demand for a new accommodation comes from the family as a social unit, from persons or groups of persons who desire to occupy dwellings for their own. There, it is a matter of great interest to remember that the household is very important in Egypt and the Eastern society, particularly in the rural settlements, because « it plays so large a part in emotional life» and because « it still flourishes as the joint family» including in one homestead all the direct male descendants with their wives and family (13).

In estimating the housing needs of the Egyptian cities, the problem is the lack of information bearing upon the family as a social and economic unit in our censuses. This problem may be approached in cities where the « joint family system» is less important by inquiring, as Ammar says, « about the number of married persons in the community». This enquiry depends upon the fact that the married are the centre of single household. However, the demand for a new accommodation in our urban centres comes from the household and from « the house shortage» (14) which can be shown from the increase of the number of persons who live per room.

However, the estimating of housing requirements in the city is perhaps more than any thing else the physical expression of planning (15). So that in any attempt to develop or redevelop the cities, especially in Egypt, it is a matter of great interest to estimate the area of the agricultural land for the future housing demand. This estimate usually depends upon the successful comparison between the population densities and accommodation densities over a definite segment. For example, the demographic study of Mahalla el Kubra shows that the number of its inhabitants as its density and accommodation are constantly changing. The settlement has grown in size from 27,851 in 1882 to 178,932 in 1960 and it is estimated that in 2000 the population will have risen to 577,000 (16). The population of Tanta also increased from 10,500 inhabitants in 1800 to 199,298 in 1960 and the estimated number of its population in 2000 will be more than 300,000. Of course this development is a measure of demand in the changing pattern of land use. In the year of 2,000 according to the estimation of the Planning Department the total required area of Mahalla el Kubra will be 9,150 feddans (17) instead of 1,400 feddans at the present time. In Tanta the area of the built up area in the year of 2000 will rise to 4,800 feddans in order to establish convenient and sufficient additional dwellings as well as to provide the future inhabitants with new residential estates. This means that the future growth of the urban settlements in Egypt will tend toward the cultivated area particularly in the surrounding fringes where the vegetables and fruits are cultivated. Such a fact is against the Egyptian Government policy which tends to increase the cultivated land. In other words, the horizontal expansion or the centrifugal development in the Egyptian urban centres, is considered such as in England one of the greatest problems of urban growth. So, our major problem is how the cities can extend without drawing much land from the agricultural. At the present time it is too late to save valuable agricultural land from suburbanism, particularly as Hamdan calls « metropolitan suburbanism (18). However, the writer believes that the « vertical field suburb» that is the best method of town planning in the future which could prevent the overlapping of cities over the rural settlement area, and conserve much land that is now the victim of the erosive centrifugal

development of suburbanism. The « vertical field suburb» is similar to the « vertical garden city» of Le Corbusier (19). The superimposed individual dwelling replace the present individual houses dispersed on the agricultural land. The difference between the « field suburb» and «garden city» is that the built up area will be islands in the cultivated land, not in a large garden. This farm land will be used as recreational parks providing the residential units with the sunlight necessary to the health of the body and the mind.

It is important to remember that though clubs and playing field are included in the present plans of cities, it is the inevitable tendency for adults to desire to walk in the open country. Indeed the psychology of walking in the country side is as important as visual enjoyment in the national character. For this purpose we hope to utilise the river banks as most attractive sites for paths in the new suburbs. Also canal two-paths are even more valuable and could make a great contribution to the « vertical field suburb» recreations. In the creation of the suggested plan it is necessary to protect the field crops by establishing a field hedge or a fence such as in England. Some one will ask where the children can play ? The answer will be that a central park should be provided all the amenities for children's recreation. In addition the inner courts between buildings should be utilized for the children playing.

The location of industry :

One of the most important principles of city planning is the removal of the industrial buildings to the city outskirts. The reason behind the process of factory decentralization may be found in the answer of the following two questions :

First, What is the best location for a factory in order to produce the maximum industrial efficiency ? Secondary, What location of homes for the industrial employees and manufacture is most suitable for the city development as a whole ? In connection with the former question it is important to remember that the following factors which have a great influence on siting selection of industry.

(*a*) The price of land.

(*b*) The provision of adequate space, unbroken and uninterrupted by public streets.

(*c*) The presence of the ample and convenient freight facilities and railroad sites (20).

The second question may be answered in the favour of the peripheries for three reasons as Nolen says :

1. The city needs its inner or central area for the business and the commercial utilization.
2. It is desirable for the inner district within the city to be free from the nuisance which are often associated with the manufactures locations. It may be noted that this point has justified the designing of the outlying industrial zone in the European cities.
3. The street system in the city, so far as possible, should be relieved from the unnecessary hauling of raw materials of the factory's products to and from the factory through the built-up areas.

Also the advantage of the houses workers' location in the fringe is not less than the advantage of the industrial decentralization. This means that the establishment of the factory employees homes in the fringe near the industrial siting, not in the same zone, gives the workers the opportunity to utilize the surrounding farms as a « lung» and at the same time the proximity to factory saves the times and car fare. Another benefit factor is the relatively cheap land.

It is well to bear in mind that the siting requirements of factories depends upon the type of industry more than the mere desire for decentralization. In other words most of the light industry tends to occupy a selected location in the commercial districts because their circulations depend upon the pedestrian traffic as well as the residential locations. The highway facilities, the water navigation and the large block of land are unimportant factors for the light industry. So it is necessary to establish this type of industry within the central area. The other heavy industry which cannot be carried on in the business district according to its siting requirements, it is desirable to move away from the city. This should be located in a special zone.

The location of schools :

This type of location involves residential and non-residential schools for childrens and also for adults. Of course, each type of school or college needs special siting requirements. For example, the area of land required for the secondary school amounts sometimes in England to 6 acres without playing field, while the primary school are not always provided with playing fields (21). Also the location of non-residential colleges diverts from the residential colleges. The latter must be near residential and non-residential schools in the inhabitable district away from the central area.

Proximity to the houses and accessibility to schools are important items in choosing the site of schools. In other words the school must be situated within a small walking distance for the children on quite roads in the centres of the residential areas served.

The site of public buildings :

The group of public buildings includes the local government buildings and the places of entertainment. Usually these buildings exist in different locations, but the best location for the public library, assembly halls and community centres, is that site which encourages the maximum use of the buildings by the public. However the public buildings of any city can be divided into two groups from a site point of view.

(*a*) The public buildings of this category encourages the maximum use by the inhabitants of the city and they occupy usually suitable areas within the central area such as the municipal museum, public library, police headquarters ... etc.

(*b*) The second category involves all buildings which cannot have the maximum use by the city dwellers because they are located in most times away from the main population groupings.

The location of storage warehouses :

The grain stores, transit warehouses and cotton « shoonahs» are classified under the storage warehouses locations. The suitable location

for this type of utilization is peripheries not the inner districts or the central area because the larger transit and storage warehouses are connected with the circulation of transit.

The location of whole sale warehouses :

The whole sale warehouses are defined as buildings which are designed both for the storage of goods and the transaction of business, other than retail business related to such goods (22). This definition shows that the whole sale can be located in the business district. Usually their sites are distinguished by the decrease of the volume of the pedestrian traffic.

The location of business shops :

This point does not need much discussion because it is a general rule that the prosperity of shopping centre depends on the volume of pedestrian traffic and ease of access by public service vehicles and motor cars. The striking feature, which appears in most of the shopping districts of the Egyptian cities, is the inadequacy of car parks and routing of public services. So it is important in the « urban renewal» (23) to provide our cities with sites for car parks.

The location of markets and the slaughter house :

Although each type of market has special siting requirements, it is desirable in general for such fairs (except the livestock market) to be placed outside the inner district but near to the central area. While it is possible to establish the warehouses market near to the shopping zone with special considerations to its traffic needs (24), the livestock market should be located in the city's peripheries. The other retail markets, e.g. the vegetable and fish market should be distributed though the residential quarters. The pedestrian circulation and the inhabitants demands are important factors in determining the suitable locations for the market.

POPULATION GROUPINGS AND DISTRIBUTION OF SERVICES

Chabot in his « les villes» mentioned that « la vie même de chaque habitant, la satisfaction des ses besoins, des ses plaisirs posent aussi des problèmes que l'individuel ne saurait resoudre isolement et qui doivent être étudiés dans le cadre général de la cité» (25). This shows that the lack of accord between the distribution of population groupings and the distribution of services is one of the main problems which require careful planning, based on real knowledge of community needs and the geographical arrangement of the services areas of shops, schools, mosques ... etc.

These are some of the question which confront the scholar in this connection. The first one is what service is necessary to provide in a certain district ? How should the buildings be sited so that the community may be served most adequately and economically ? When does it become necessary to provide an additional unit of same particular service-another school, hospital or cinema ? (26) which institution should have priority claims upon central sites ? and which can with greatest or least disadvantage be distinguished further field ? (27).

The answer of these questions depends upon the number of people which are required to maintain different services and the spacing of community services. In other words the number of inhabitants various greatly from one service to another and so does the range of the service unit, *i.e.* « The maximum extent of area that can be served from a single centre» (28). It may be noted that the general principle which governs the geographical distribution of some services, e.g. educational, recreational and medical, can be summarised as follows. The more necessary services which are required by every one need to be available locally at a large number of centres, e.g. mosques, elementary schools, post offices and police stations are normally conveniently located in the part they serve while those that serve the whole city are found in a central position. However, the location of services institutions depend upon the density of population, the social character and the standard of the area they serve (30).

MANSURA : AN EXAMPLE OF THE RELATIONSHIP BETWEEN POPULATION GROUPINGS AND COMMUNITY SERVICES.

The present distribution of the public services of Mansura shows some highly suggestive facts :

A. — The main local government offices are situated in the quarters of Bahr-es-Saghir away from the great concentration of population in the districts of El Hawar and Mit Talkha. It is not important for these buildings to be in close proximity to the overcrowded segments or to create « deadpoints» in the shopping zone because they serve the needs of all the city dwellers in addition to the inhabitants of the surrounding settlements. The educational head-quarters, the Health Inspectorate, the police centre, the principal post-office, the telephone exchange centre and the other public buildings which have the maximum use by the population are located just of the modern shopping zone. It is to be remembered that most of the above mentioned main offices are situated, from the communication and accessibility point of views, in the most convenient and most reasonable places.

B. — The public institutions, which include the recreational centres, occupy, from the service point of view, suitable locations. They are distributed in the western, the north eastern and the S.E. fringes where there are adequate space and at the same time serve the whole community. To interpret this point it may be noted that the inhabitants of the ancient districts as well as of Twril and Mit Talkha find their way easily either to the city stadium or the municipal garden. This is because they have a good access in addition to the Nile side parks which attract the majority of the city dwellers.

C. — The mosque like the church in the western world, is considered one of the most important public buildings in the Middle East. The distribution of mosques in Mansura is similar to that in the other Egyptian settlements. It shows on one hand the concentration in the centre and the ancient quarters and it reveals on the other a virtual absence of

mosques in the outer, newly built up areas. This fact suggests that the inhabitants of the fringe districts need to be served by more religious centres. It is important to point out that the distribution of mosques does not correlate with the community groupings because there is not plan for the establishment of new mosques according to the fact that our mosques are built usually by the benefactors and not by the Government. This could be shown by the mosque's names which are derived from the names of their benefactors. It is noteworthy that there are ten churches in the city. Six of them are found in the central district and the other exist within the cemetery area.

D. — The map of distribution of hospitals in the city reveals that most of the hospitals are located in a special area in the Western fringe. Here there are the local Government hospital which is considered one of the biggest hospitals in the Delta, the Fever Hospital ... etc. Although these hospitals are situated in suitable location near to the main population concentration in El Hawar and Mit Talkha, they serve the whole population grouping in the city as a result of the accessibility to their site.

E. — The observation of school distribution, the major sociogeographical aspect of town planning (31), shows that most of the secondary and technical schools are located in two segments, namely, the western and the N.E. districts. Although this centralization, particularly in the Western periphery, serves mainly the population grouping in the ancient quarters it seems clear that it is not optimal because the catchment area of some of these schools does not occur only in the old districts or in a certain quarter but stretches over all the city as well as its suburbs. This means that the advantage of centralization or decentralization is determined by the accessibility from the city as a whole, not only from the surrounding quarters. To explain this point one takes the Secondary industrial school (map 4) as an example of the disadvantage of the above mentioned centralization. This school is the only industrial institute in the city and is situated in the Western fringe just beside the Mansura Secondary school. Such a location gives the inhabitants of the districts of Mit Talkha, El Hawar, Rihan and the other ancient quarters the advantage of approach to the school. While the student who resides

in Twril must adapt any kind of transport means or walk more than three kilometres in order to arrive at his institute. Also one who lives in the south eastern quarters must leave his home at least an hour before the school day starts. The same phenomenon appears through the catchment area of the other schools such as the New Secondary commercial school for girls which is located in the same area. This may be taken to indicate that it is necessary to select the location of schools in relation to the distance as well as the number of inhabitants and the accessibility.

Appended to the technical and secondary schools are six other training colleges for men and women teachers. The principal training colleges for men teachers is located in the quarter of El Nagar within the main population grouping, while the other colleges are distributed through the ancient quarters and serve all the population of the city. In connection with the distribution of elementary and preparatory schools it may be stated that it is difficult, according to the lack of data bearing on their location to analyse the relation between the population groupings in the various segments and the number as well as the site of these schools. Generally speaking, the city has at the present time 55 elementary schools and 29 preparatory schools. Most of the latter type of school are found near to the secondary and technical, while the elementary schools are distributed through the residential quarters in order to be within about ten minutes from the homes of their pupils without their having to cross any dangerous main throughfares (32).

F. — The distribution of banks shows that there are few banks in the city (Map 2). All the financial organizations except the Agricultural Loan Bank are centralized in the Nile ". just off the modern shopping district. The Agricultural Loan Bank is situated in Bahr-es-Saghir ". and its site is distinguished by the accessibility from the main means of the farmers' transport, the country bus terminal and the Delta Light Railways. Attention should be drawn to the fact that the low income prevents most of the inhabitants from making full use of the banks' facilities. So the majority of banks avoid being located in the residential district or in the local shopping centres because they find it is more convenient and suitable to be situated near to the economic circulation

within the shopping zone. However, the pattern of banks distribution is sufficient, from the economic point of view, to the needs of a modern city.

G. — Appended to the public and economic services is the distribution of the local shopping centres. Here it is instructive to state that with transportation facilities, the relationship of shop location to whole sale sources of supply is not important. What matter is its relationship to the consuming public, which means mainly to their homes, and in some degree to their places of work and their travelling route between home and work. Naturally each consumer desires to have shops as near as possible to her own home and at the same time, when she shops she naturally wishes to choose from a satisfactory range of goods (33).

In Mansura it is difficult to delineate special areas as local shopping centres because the few retail shops which comprise the local shopping centre are distributed in haphazard « laisser faire» system through the residential area. However, there are in the city, beside the principal commercial districts, two important local retail centres. The first one, which serves the needs of the community grouping in the eastern and the north eastern districts (34), is situated in the Mudiriya ". The second centre stands in el Hawar ". and serves the population of Mit Talkha and El Hawar in addition to the eastern rim. The distance between the consumer and the local shopping centre in the former centre is about one kilometre against half a kilometre for the second.

H. — Lastly it is of interest to consider the distribution of post boxes in order to explain the relationship between their pattern and the distribution of population (35). The map No. 5 shows that the outskirt districts, namely, Twril, El Mokhtalt Kafr el Badmasi, Bahr-es-Saghir, the Western and the S.W. segments, are inadequately provided with post services. The map reveals that most of the post boxes are located in the main streets within the central zone. To illustrate the disadvantage of this pattern it may be noted the inhabitants who live in any segment of the new residential district must walk at least ten minutes in order to post his letter. Moreover the trader as well as the inhabitant of El-Nagar and Rihan cannot find any post box near to his dwelling because all

post boxes within these area are found away from their dwellings. All the above mentioned facts emphasize the lack of post services in the various quarters of Mansura. So, the city council has decided in 1962 to establish a « model post office» in each of the districts of Mit Hader, Seyam, Sandub, Gedila, El-Nagar and Bahr es Saghir.

URBAN AESTHETIC

In town planning the geographer is concerned with the site, the economic and social elements which have had more or less influence in shaping the form and outline of cities, but he is also concerned with the type and the appreciation of beauty or the lack of beauty of the city. This is because, as Van Cleef says, the urban centre is the climax expression of man's cultural attainment in a given natural environment (36). This means that one must study beside the natural scene, the buildings and the groups and how they fit into the landscape as a whole.

It is well known by the designers that the beauty of any city depends on the relative shops and disposition of one building to another and to the distance from one side of street to other. It depends also, as « upon the appearance of its houses, monuments and the architectural aesthetics of the time» (37). In all Egyptian centres the modern architecture has evolved as a result of the application of new constructional methods and new materials. It has produced new forms of buildings quite different from those of the past. The functional and social requirements of present day, *i.e.*, commerce, industry and social services, can not satisfactorily be met by the use of outmoded styles of medieval architecture with its narrow and winding streets and with its high walls which « enclosed small yard on to which various flat room opened» (38). This style was intended to satisfy the need of the Middle Ages when the mosque with its near by market place was the community centre of town, when the streets were primarily pedestrian, and also when communication were seldom symmetrically planned (39). Although this outmoded style is the distinct characteristic of the original care of the Egyptian city, the rest of the city has a street pattern of some sort. These streets are generally composed of vehicular traffic ways bounded

by pedestrian paths and have along their sides a serious of buildings which have direct access to these streets. The disposition of buildings on the street is considered in relation to the street as a whole. Generally speaking, the streets of the Egyptian urban centres fall, from the aesthetic point of view, into two categories. The first one includes those streets which exist in the new residential quarters and which suffer from « infinite variety». Each street in this group is composed of an astonishing jumble of unrelated building without any sense of coherent design, colour and structure. The fault of these streets, as Stewart writes, is the absence of the relationship between « the individual components» (40).

The second caregory contains those streets which are distinguished by the lack of beauty and variety. The streets of this division appear in the ancient quarters where the rows of brick houses without convenient space overlook the street.

CONCLUSION

The site becomes at the present time, a matter of interest (41) because the main aim of planning is to allot adequate areas for buildings development in appropriate places where necessary public services could be adequately and economically provided, to stop sporadic growth every where, and to preserve the agricultural land as far as possible, from urban expansion.

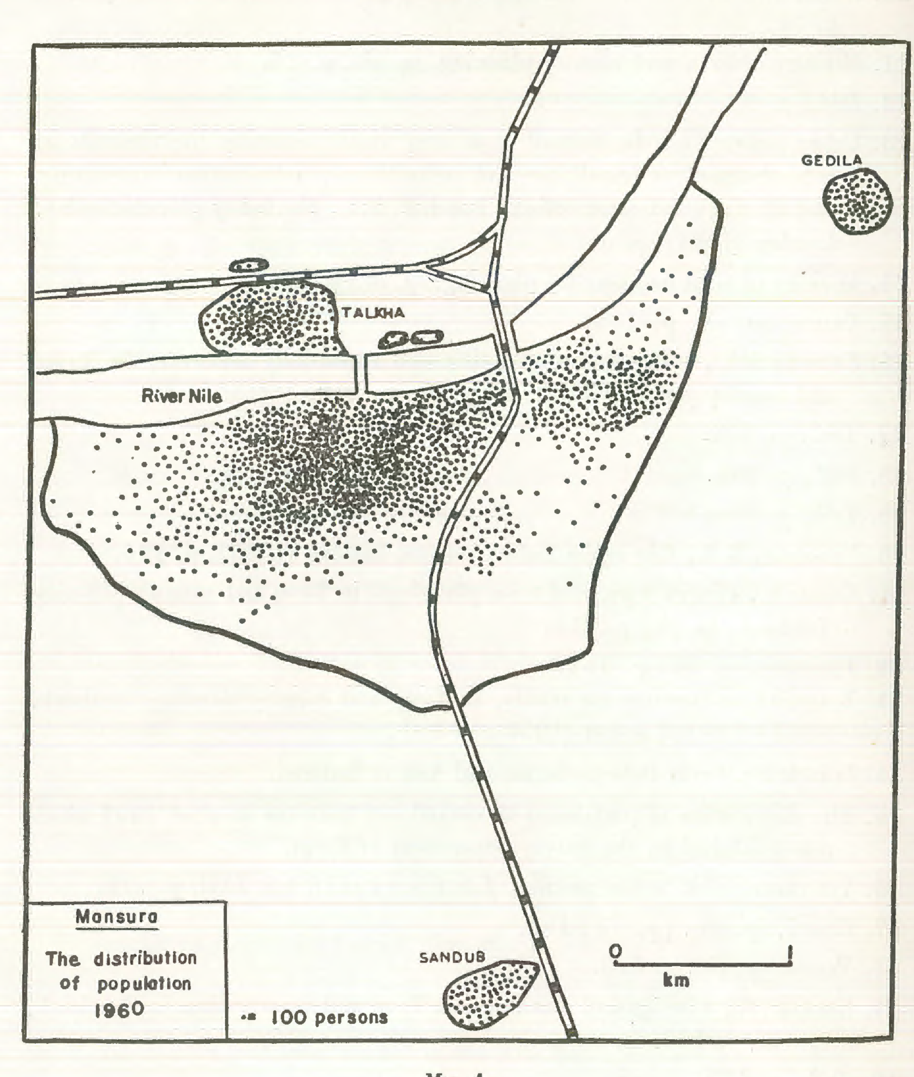
Proper planning determines what steps are necessary to serve the urban centre as completely and as economically as possible (42). These services mainly concern schools; cultural institutions (Kulturorgane), parks, playgrounds and utilities.

In general terms, the time for national wide co-operation in Egypt has yet to come by the close co-operation between the planners, the economists and the geographers, who are concerned with the relation between man and his environment (43).

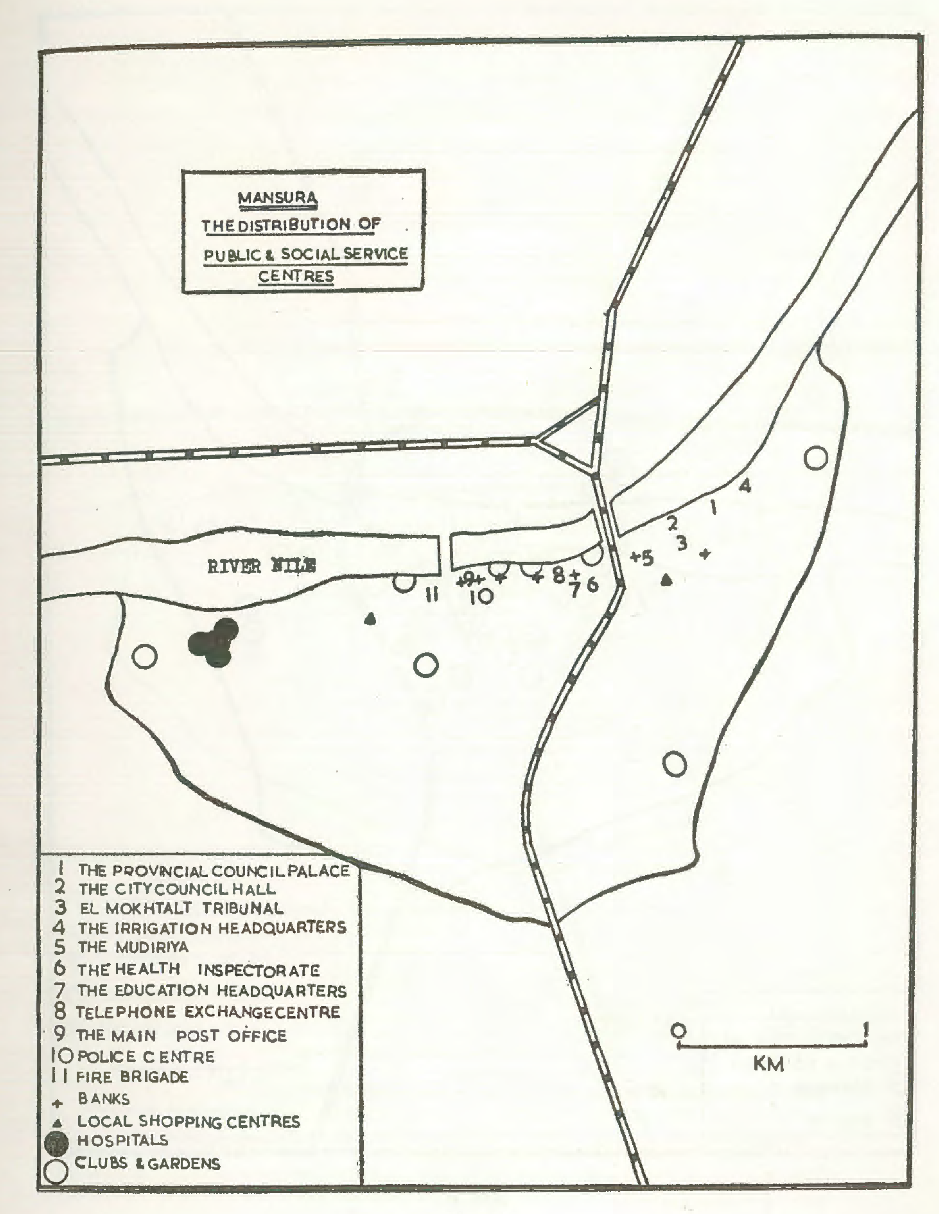
REFERENCES

1. M.J., Wise, « On the evolution of the Jewellery and gun quarters in Birmingham », Transactions, papers, *The Institute of British geographers,* (1947), p. 72.
2. Wooldridge, S.W. and East, W.G., *The spirit and purpose of geography,* London, (1956), p. 28.
3. Taylor, G., *Urban geography,* London (1949).
4. Chabot, G., *Les Villes,* Paris (1952), p. 99.
5. Fleure, H.J., *The regional survey preparatory to town planning,* London (1918), p. 33.
6. Ministry of town and country planning, *The development of the central area,* London (1947), p. 24.
7. *Ibid.,* p. 26.
8. H. Myles Wrigh, *The planning notebook,* London (1948), p. 210.
9. Tyrwhitt, J., « Society and environment », in Town and country planning Textbook, edit by *APRR,* London (1950), p. 136.
10. Pearson, S.V., *The growth and the distribution of population,* London (1935), p. 376.
11. Pitt Rivers, G., « Regional planning in relation to population movement », *Population Journal* (1936), vol. 2, p. 30.
12. Glass, D., « Population studies and housing needs », in Town and country planning Textbook, *op. cit.,* p. 225.
13. Ammar, A., *A demographic study of an Egyptian province* (Sharquia), London (1941), p. 32.
14. House shortage refers to houses for people who live more than two in a room, or more than two persons per bedroom, whose homes are in cramped and squalid surrounding, Pearson, *op. cit.,* p. 369.
15. Thomas, D.I., « Local government and health of the city », *Planning Outlook* (1950), vol. I, p. 76.
16. El Gowhary, Y., « Urban Studies in the Nile Delta from the beginning of the 19th century on wards », *A study in Historical geography, unpublished thesis, Ph. D., Reading* (1964), vol. 2, p. 25.
17. At the present time the total area of Tanta is 3.012 feddans. The houses and the other built up areas occupy about 1,000 feddans and the remaining are utilized in cultivation, *ibid.,* p. 402.
18. Hamdan, G. « Evolution of irrigation agriculture in Egypt », in *A history of land use in Arid region,* UNESCO, ed. L.D. Stamp (1961), p. 134.

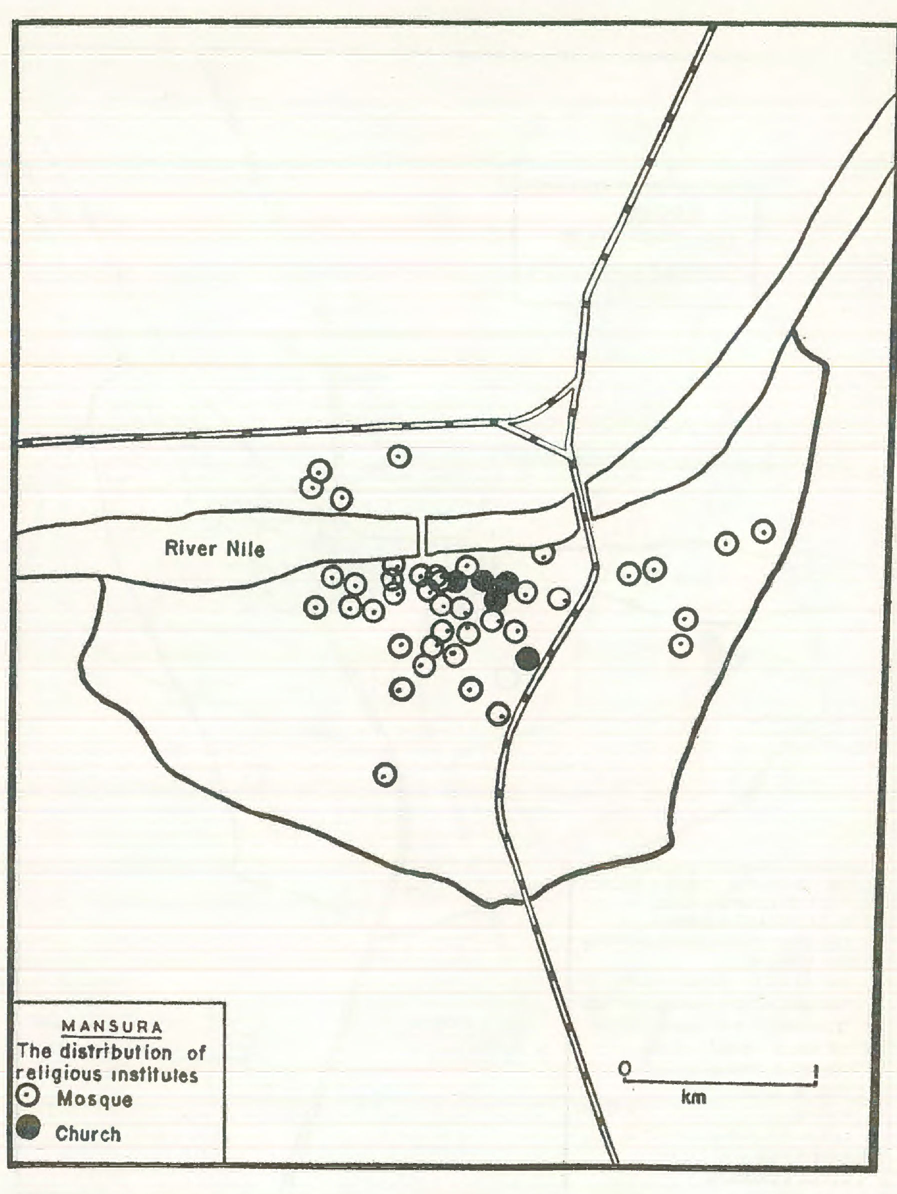
19. El-Gowhary, *op. cit.,* p. 403.
20. Nolen, J., *New ideas in the planning of cities, town and villages,* London (1919) p. 88.
21. Ministry of town and country planning, *op. cit.,* p. 26.
22. *Ibid.,* p. 90.
23. Urban renewal can be defined as a term which comprises the elements of redevelopment « demolition and rebuilding », rehabitation « repairing and altering » and conservation. Powdrill, F.A., *Vocabulary of land planning,* London (1961), p. 55.
24. Ministry of town and country planning, *op. cit.,* p. 29.
25. Chabot, *op. cit.,* p. 162.
26. Smailes, A.E., « Population grouping and community services », in Town and country planning Textbook, *op. cit.,* p. 242.
27. *Ibid.,* p. 242.
28. *Ibid.,* p. 243.
29. *Ibid.,* p. 244.
30. Dickinson, R.E., *City region and regionalism,* London (1947), p. 136.
31. Glass, R., « Social aspects of town planning », in Town and country planning Textbook, *op. cit.,* p. 215.
32. Dickinson, *op. cit.,* p. 150.
33. Baker, D., « Planning for retail », in Town and country planning Textbook, edit by *APRR,* London (1950), p. 291.
34. It includes Twril, Bahr es-Saghir and Kafr el Badmasi.
35. The distribution of post boxes is worked out from the map of 1951 which was published by the Survey Department of Egypt.
36. Van Cleef, « The urban profile », *A.A.A.G.* (1932), vol. XXII, p. 239.
37. Chabot, *op. cit.,* pp. 152-153.
38. Taylor, *op. cit.,* p. 320.
39. Stewart, G., « Design and planning », in Town and country planning Textbook, *op. cit.,* p. 188.
40. *Ibid.,* p. 182.
41. Pepler, C., « Forty years of planning », in Town and country planning Textbook, *op. cit.,* pp. 456-457.
42. Bergel, E., *Urban Sociology,* N.Y. (1955), p. 458.
43. Fleure, H.J., *Geography and the scientific movement, Geography* (1932), vol. XXII, p. 180. — Stamp, L.D., « Applied geography », *A pelican book* (1961), pp. 18-19.


GEDILA
TALKHA
River Nile
SANDUB
0 km 1
Mansura
The distribution of population 1960
= 100 persons

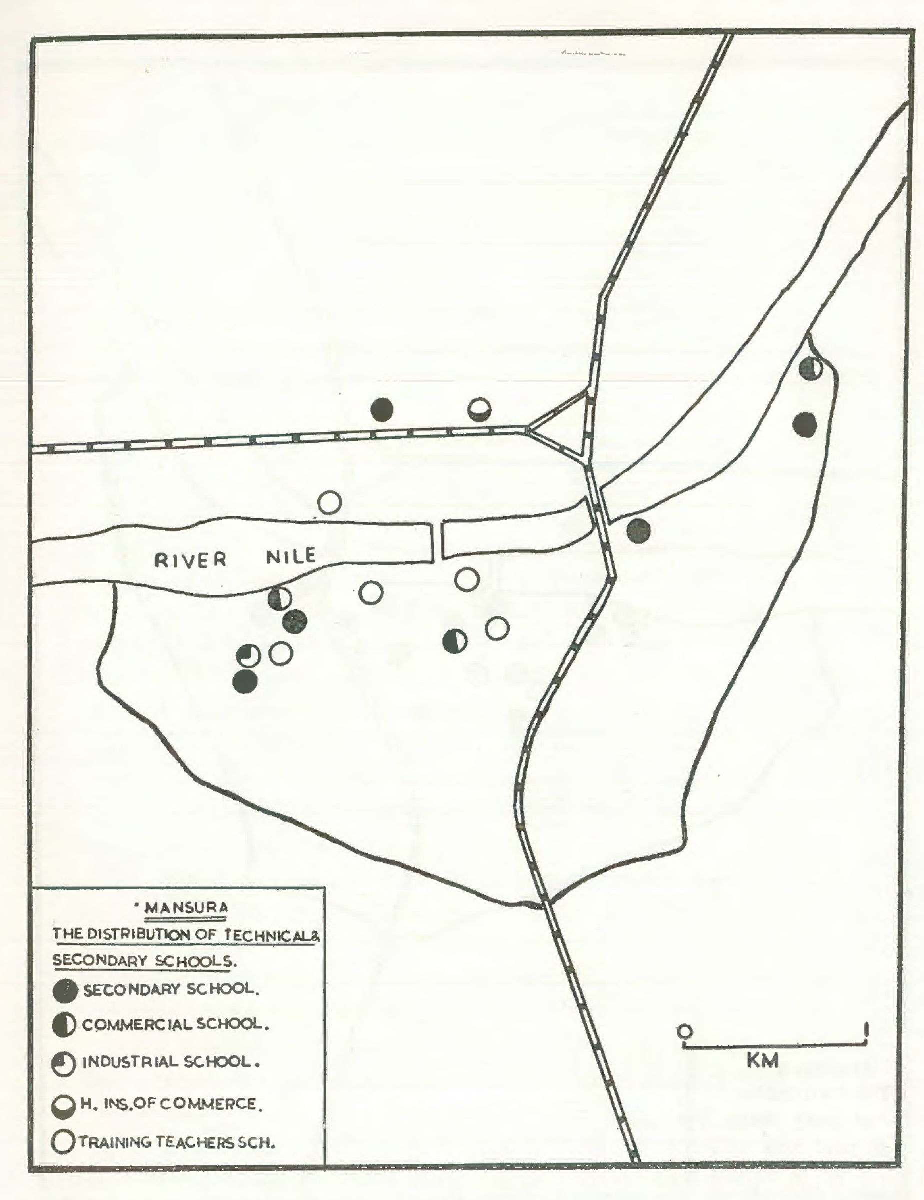
MAP 1


MANSURA
THE DISTRIBUTION OF PUBLIC & SOCIAL SERVICE CENTRES
RIVER NILE
0 KM 1
1 THE PROVINCIAL COUNCIL PALACE
2 THE CITY COUNCIL HALL
3 EL MOKHTALT TRIBUNAL
4 THE IRRIGATION HEADQUARTERS
5 THE MUDIRIYA
6 THE HEALTH INSPECTORATE
7 THE EDUCATION HEADQUARTERS
8 TELEPHONE EXCHANGE CENTRE
9 THE MAIN POST OFFICE
10 POLICE CENTRE
11 FIRE BRIGADE
BANKS
LOCAL SHOPPING CENTRES
HOSPITALS
CLUBS & GARDENS

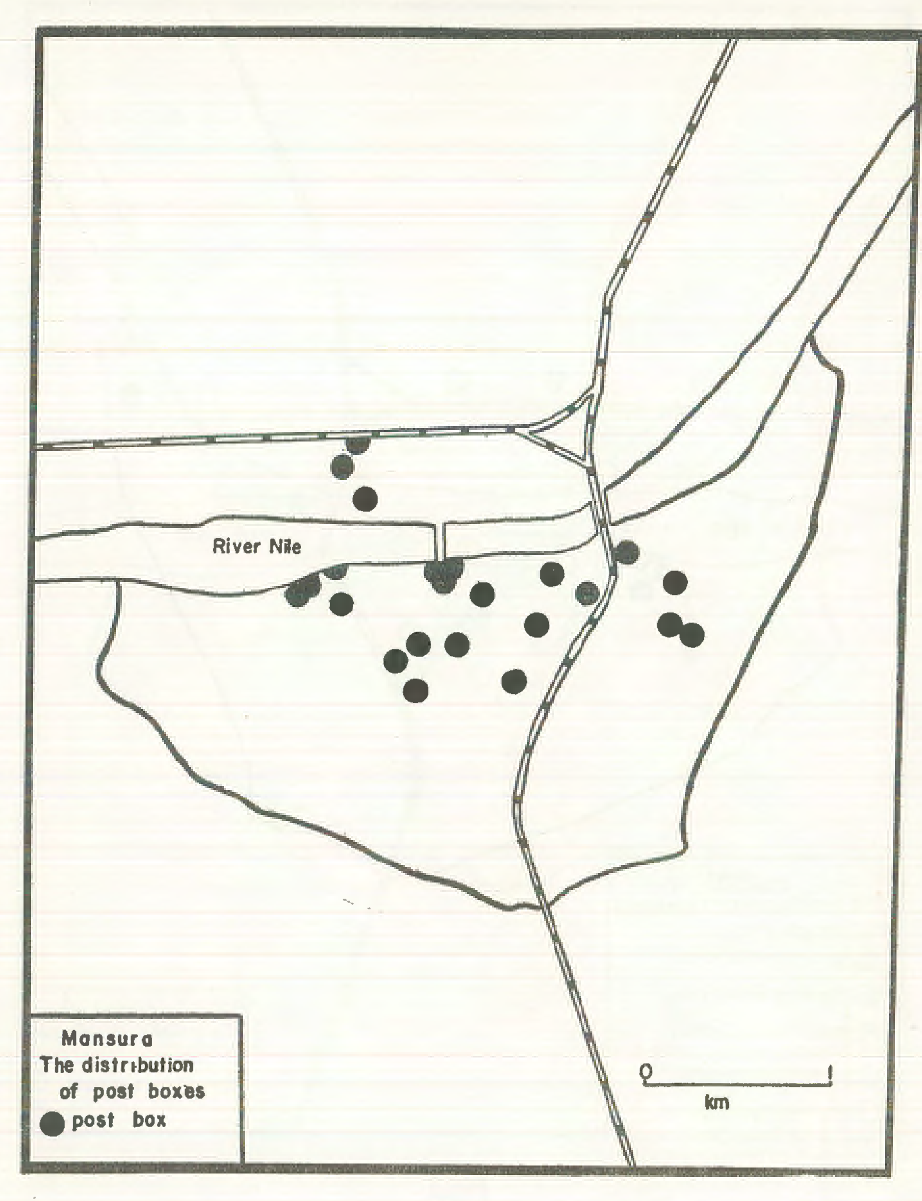
MAP 2


River Nile
MANSURA
The distribution of religious institutes
Mosque
Church
0
1
km

Map 3


RIVER NILE
MANSURA
THE DISTRIBUTION OF TECHNICAL & SECONDARY SCHOOLS.
SECONDARY SCHOOL.
COMMERCIAL SCHOOL.
INDUSTRIAL SCHOOL.
H. INS. OF COMMERCE.
TRAINING TEACHERS SCH.
0
1
KM

Map 4



MAP 5

MICROCLIMATIC CONDITIONS IN WADI HOFF

BY

A. A. ABD EL RAHMAN AND K. H. BATANOUNY
(BOTANY DEPARTMENT, FACULTY OF SCIENCE, CAIRO UNIV., EGYPT-U.A.R.)

SUMMARY

Generally the climate of the Egyptian deserts in characterised by extreme aridity and high temperature. The studied area so widely different in topography of its various parts, affords a great opportunity to study side by side contrasting environments in which a species can or cannot occur. Four spots were chosen as stations for microclimatic study : (1) represents a spot located on the plateau, (2) representing a shaded site, (3) located on the first terrace of the wadi bed and (4) a west facing slope.

The plateau is the most exposed microhabitat to wind, solar radiation and evaporation. The high evaporating power of the atmosphere in this microhabitat is one of the important factors which cause the sparcity and openness of the vegetation.

The shaded microhabitat is the coolest microhabitat, and it exhibits the lowest V.P.D., wind velocity and evaporation. The relatively rich vegetation with vigorous plants and the low rate of water expenditure by plants growing in the shaded area may be referred to the mild conditions prevailing in this microhabitat.

In the wadi bed, the temperature is lower than on the slope, but higher than in the shaded area and the plateau. The wind velocity and evaporation rate are lower than in the plateau and the slope, but higher than in the shaded microhabitat. The V.P.D. in the wadi bed is higher than in the plateau, though the plant cover is denser in the former than in the latter.

On the west facing slope, the air temperature is the highest in record except in June. The evaporation rate and wind velocity are lower than in the plateau, but higher than in the other microhabitats.

The soil temperature in the different spots is affected primarily by the degree of their exposure to sun.

INTRODUCTION

For the individual plant, « the standard climate», as measured in a meteorological screen, is less important than the « eco-climate», which expresses the sum total of environmental factors within the plant habitat. Both vertical and horizontal contrasts between the macroclimate of any region and the climate near the ground, (the microclimate) was defined by Geiger (1959). Geiger speaks of the microclimate as « climate in the least place».

Kachkarov and Korovine (1942) stated that in the deserts, the microclimatic conditions are perhaps of greater significance to the existence of animals and plants than the regional climate.

Available data concerning the microclimate under desert conditions are few and do not represent all conditions. In wadis, for example microclimatic and other environmental conditions are widely different in the various sites namely plateau, bed and slope. Detailed study of the microclimate has a great value since it throws light on the distribution and characters of the vegetation.

MACROCLIMATE

Generally, the climate of the Egyptian deserts is characterised by extreme aridity and high temperature (Table 1). There are wide ranges of temperature and humidity, both annual and diurnal. Rain is scanty in general and varies widely in different years, with an average of 31 mm., Winter is the rainy season and there is a prolonged rainless period covering 8-9 continuous months. The number of rainy days is limited, not exceeding 5 or 6 every year.

Applying the following formula of Emberger (1952) to the studied area, we get :

$$Q^2 = \frac{P}{(M+m)\ (M-m)} \times 1000$$

where Q is the pulviothermic quotient, P the annual precipitation in *mm*, M the average maximum temperature in the hottest month, and *m* the average minimum in the coldest month. M and *m* being expressed

TABLE 1

Seasonal fluctuations in the different climatic factors
(Data obtained from the Meteorological Station at Helwan Observatory)

YEAR	MONTH	AIR TEMP. (°C) MEAN MAX.	MEAN MIN.	MEAN	R.H. (%)	WIND VEL. (KM /H.)	EVAP. (MM./DAY)	RAINFALL
1959	September	31.0	19.0	24.5	60.0	18.3	10.93	drops
	October	27.4	16.1	21.2	60.0	17.7	9.22	0.3
	November	25.1	14.2	18.9	59.0	16.9	8.25	drops
	December	21.7	8.2	15.1	63.0	2.0	3.80	12.5
1960	January	—	—	13.2	65.0	—	—	6.7
	February	21.5	9.9	14.8	65.0	15.1	6.86	—
	March	24.9	11.5	17.3	54.0	15.6	9.61	drops
	April	29.1	15.9	21.9	46.0	16.1	8.90	—
	May	33.6	18.7	25.6	38.0	20.1	15.04	0.3
	June	33.1	18.9	25.6	49.4	20.2	13.20	—
	July	34.8	20.7	27.2	54.0	18.9	12.83	—
	August	35.0	21.4	27.4	59.0	18.6	11.97	—
	September	33.0	20.2	25.6	57.0	18.7	14.70	—
	October	33.1	30.4	25.8	52.0	21.6	12.02	—
	November	25.4	15.7	26.1	72.0	14.7	6.40	2.3
	December	24.2	14.5	18.1	65.0	14.9	7.05	drops
1961	January	19.1	9.8	13.5	60.0	12.0	5.20	5.1
	February	17.3	8.0	12.0	64.0	15.9	5.88	9.4
	March	21.2	9.5	14.9	67.0	14.5	8.30	—
	April	28.2	14.0	20.8	50.5	18.4	11.73	—
	May	33.0	17.8	24.6	42.0	18.0	14.72	drops
	June	36.6	22.1	28.8	34.0	19.0	17.22	—
	July	—	—	—	—	—	—	—
	August	34.0	21.6	27.1	60.0	16.56	11.39	—
	September	30.4	18.8	24.0	58.0	17.2	10.56	—
	October	28.1	17.4	22.0	63.0	17.9	8.24	1.8

in absolute degrees (0° C = 273°) to avoid the degrees below 0° C. The pulviothermic quotient is found not to exceed 1.95. Since the value of « *m* » for Helwan is 8.1° C, it is concluded that the region studied has a Saharan Mediterranean climate according to the classification made by Emberger in 1955.

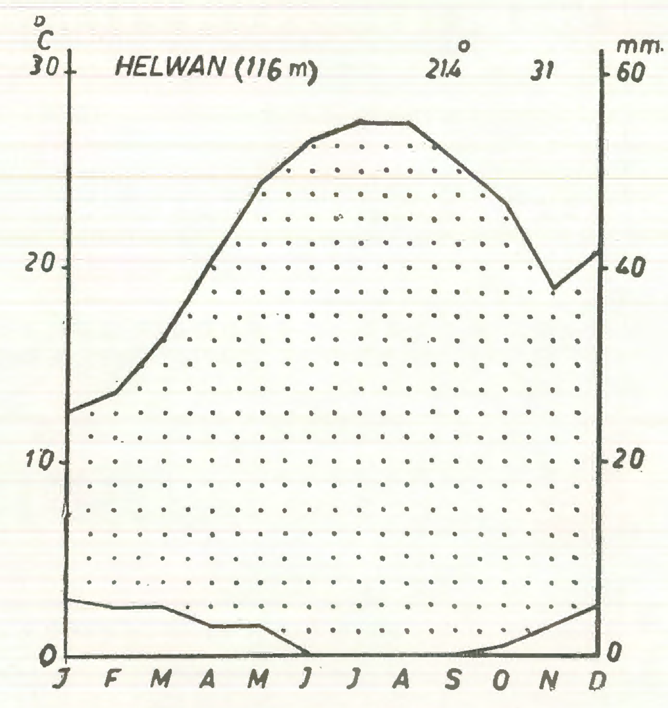


Fig. 1. Clima-diagram of Helwan according to the system suggested by Walter.

Another method of expressing the climatic aridity of the area under study is by means of the «clima-diagrams» suggested by Walter (1955-1957 and 1959). In Fig. 1 the diagram shows that the precipitation curve underlies the temperature curve throughout the year. According to the Walter's map of the clima-diagrams of Africa 1958, the climate of this region is of the extremely arid type (Type 3).

THE MICROCLIMATE AND ITS RELATION TO TOPOGRAPHY

The environmental differences which exist between adjacent and contrasting habitats in hilly or mountaineous country and which accounts

for slope differences in the vegetation, are of great interest. Potzger (1939) stated that microclimate is most descriptive of local climatic variation. Oösting and Hess (1956) attributed the survival of a relic community of *Tsuga canadensis* on a North-facing bluff in North Carolina, U.S.A. to special microclimate features.

Leda Dau (1960) stated that there will be at least as many microclimates as types of obstacles. The factors that induce the seggregation of the microclimates in the horizontal plane are : the macro- and microtopography, the qualitative constitution of the substratum and the variation in the structure of the vegetation cover.

THE SITES STUDIED

The studied area so widely different in topography of its various parts, affords a great opportunity to study side by side contrasting environments in which a species can or cannot occur. The studied site is a part of wadi Hoff, which is one of the wadies of the Egypto-Arabian desert. Four spots were chosen as stations for microclimatic study (Pl. I). « A » represents a spot located on the plateau, « B » representing a shaded site at the foot of the chasm, but curved inwards below due to undercutting. As this shaded microhabitat is facing east, it receives sunlight during a short period beginning at sunrise and ending before noon. The protruding wall shortens the period of exposure to sun. « D » is located on the first terrace, and « F » on a west facing slope. Records were taken to illustrate the daily and seasonal rhythm of the different atmospheric conditions. Measurements were recorded monthly covering a period of thirteen months from January 1960 to January 1961. In every month the climatic factors were recorded every three hours over a continuous period of 48 hours. The atmospheric factors studied were air temperature, V.P.D., evaporation and wind velocity. In addition the soil temperature was measured at the surface, and at depths of 10, 25 and 50 cms. The measurements of air temperature were taken at the height of 30 cm., which represents the mean height of desert plants.

The evaporating power of the air was determined by the Piche evaporimeter. The wind velocity was measured by a Robinson anaemometer placed at the general level of desert plants. Records were taken for all microhabitats simultaneously.

AIR TEMPERATURE

It is noteworthy that the shaded spot is cooler by day and warmer during the night (Fig. 2). Actually this is the case in all the months except in January, when the plateau is the warmest habitat at night. During the night, the shaded microhabitat was warmer due to the coming out radiation from the ground, the wall of the valley and the protruding edge 1.5 meter above the ground.

The maximum temperature was reached at 1 p.m. in all the spots except the shaded one, where it is attained early at 10 a.m. in summer and autumn. This is due to maximum sunniness of the shaded spot at 10 a.m. as it is east facing.

The range of diurnal variation is narrowest in the shaded spot for all seasons (Fig. 2). The diurnal fluctuations are of wide range in the wadi bed particularly in summer and winter, but of narrow range in spring and autumn. This pertains to both plateau and slope.

The plateau is cooler than the wadi bed and the slope due to the effect of wind causing a compensatory ventilation with a resulting temperature drop, and the latter two microhabitats receive radiation from the neighbouring wadi walls in addition to solar and sky radiation.

The west facing slope with 30° inclination is warmer by day than the other microhabitats except in June. This phenomenon finds explanation by the measurements of the daily sum of solar radiation made by Marten (1926) and thoroughly analyzed by Schubert (1928). The latter found that the daily sum of the solar radiation falling on a horizontal surface and a western slope attains its maximum in June, the horizontal being higher.

The wadi bed receives more total radiation from different sources including solar and sky radiation as well as radiation from the wall of the wadi and the slope.

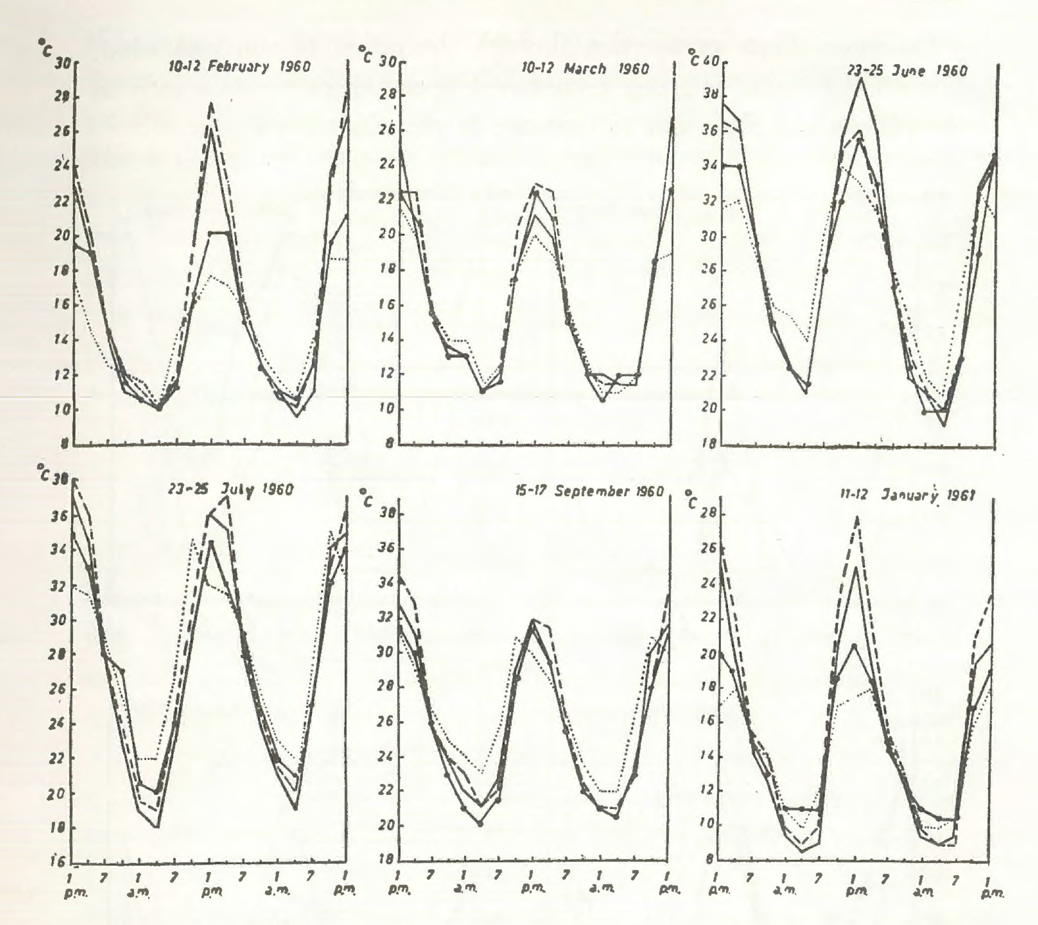


Fig. 2. Diurnal fluctuations in the air temperature in the various microhabitats in six months representing the different seasons.
Plateau —•—•— Shade ......
Wadi bed ——— Slope - - - - -

EVAPORATION

The evaporation rate has a marked influence not only on the amount of the water lost from plants through transpiration, but also on the reduction of the water content of the soil. Weaver (1938) stated that evaporation determines the efficiency of rainfall in a great measure, especially where the rainfall is less than 30 inches annually.

Exposure affects evaporation through the action of sun and wind. The effect of wind is much pronounced upon the evaporation rate on the plateau and slope due to exposure to prevailing dry winds.

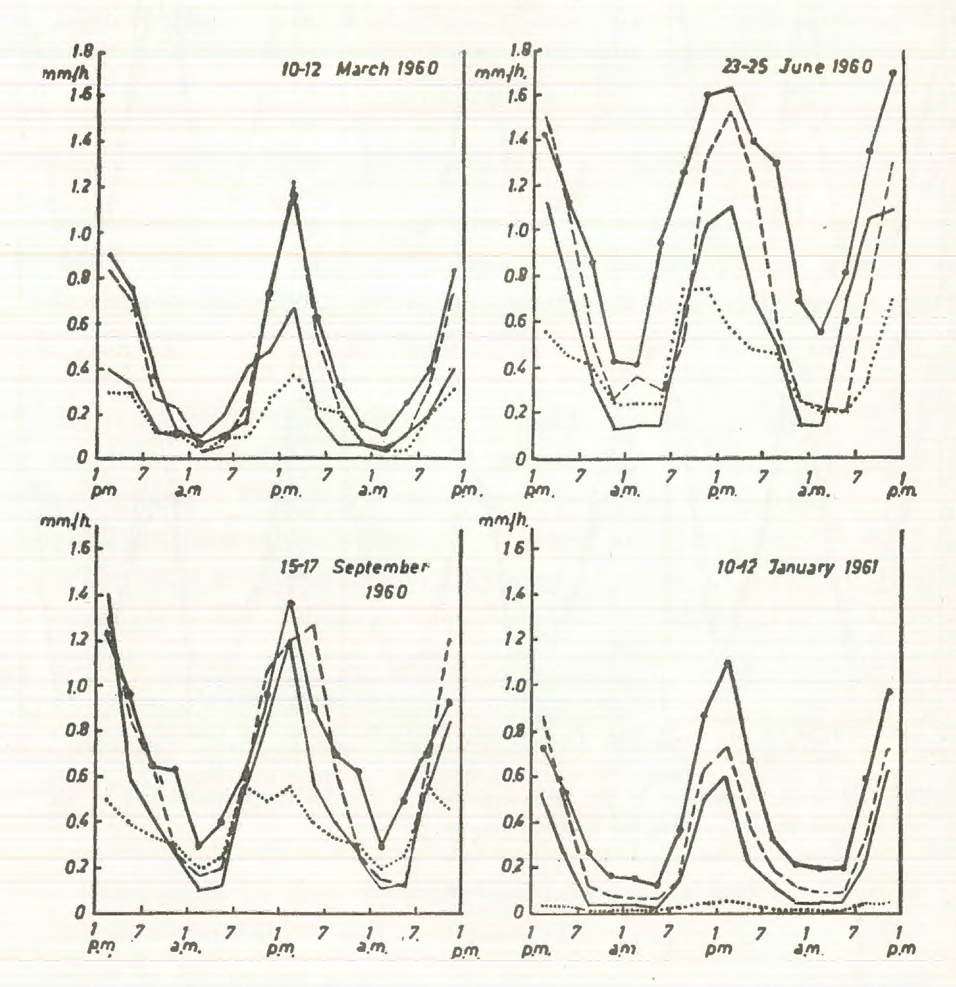


Fig. 3. Diurnal fluctuations in the evaporation rate in the various microhabitats in four months representing the different seasons.

Plateau	—·—·—	Shade	......
Wadi bed	———	Slope	-----

Examination of Fig. 3 reveals that in all seasons, the evaporation rate has a similar sequence in the four microhabitats, attaining its highest value on the plateau, followed by the slope, then the wadi and the

shaded spot. This is mainly true during the day-time. Although the temperature attained by day was higher on the slope than on the plateau, yet the evaporation rate was higher in the latter than in the former. This is mainly attributed to the higher wind velocity on the plateau than on the slope. As a general rule, the plant is less affected by air movement than the evaporimeter (Knight 1917). The wind is more active on the plateau than on the slope and in the wadi bed. Therefore evaporation rate was higher on the plateau than in the other microhabitats, though the temperature and V.P.D. of the atmosphere were much higher in the wadi on the slope than on the plateau.

VAPOUR PRESSURE DEFICIT

The march of the V.P.D. seems more or less parallel to that of the air temperature, though less regular and with wider diurnal fluctuations. From Fig. 4, it is clear that the maxima were mostly attained in the afternoon at 1 p.m., but in few cases it was attained at 10 a.m. or 4 p.m. Minimum values were recorded at night and in the early morning. High figures were recorded in summer during the daytime. The range of variations was greater in summer and autumn than in winter and spring. The maximum value was recorded in October 1960 on the slope, amounting to 55.9 mm. Hg. The minimum was recorded on 12th January in the wadi bed and amounted to 0.3 mm. Hg.

From Fig. 4, it is evident that the V.P.D. was generally higher on the slope than in the other spots in all months except in December and July 1960 when it was slightly higher in the wadi bed. The lowest V.P.D. was observed on the plateau in most months. In the shaded spot it may be lower or higher than on the plateau, but in the two spots it was generally lower than in either of the wadi bed and the slope.

It is obvious from the collected data that the mean V.P.D. in the wadi bed was generally higher than on the plateau in the different seasons, though the plant cover was denser in the first terrace than on the plateau. This points out to the negligible effect of plant cover on the V.P.D. Stocker (1928) in his studies of the water balance of Egyptian desert plants, came to the conclusion that « There is no case where a rise of

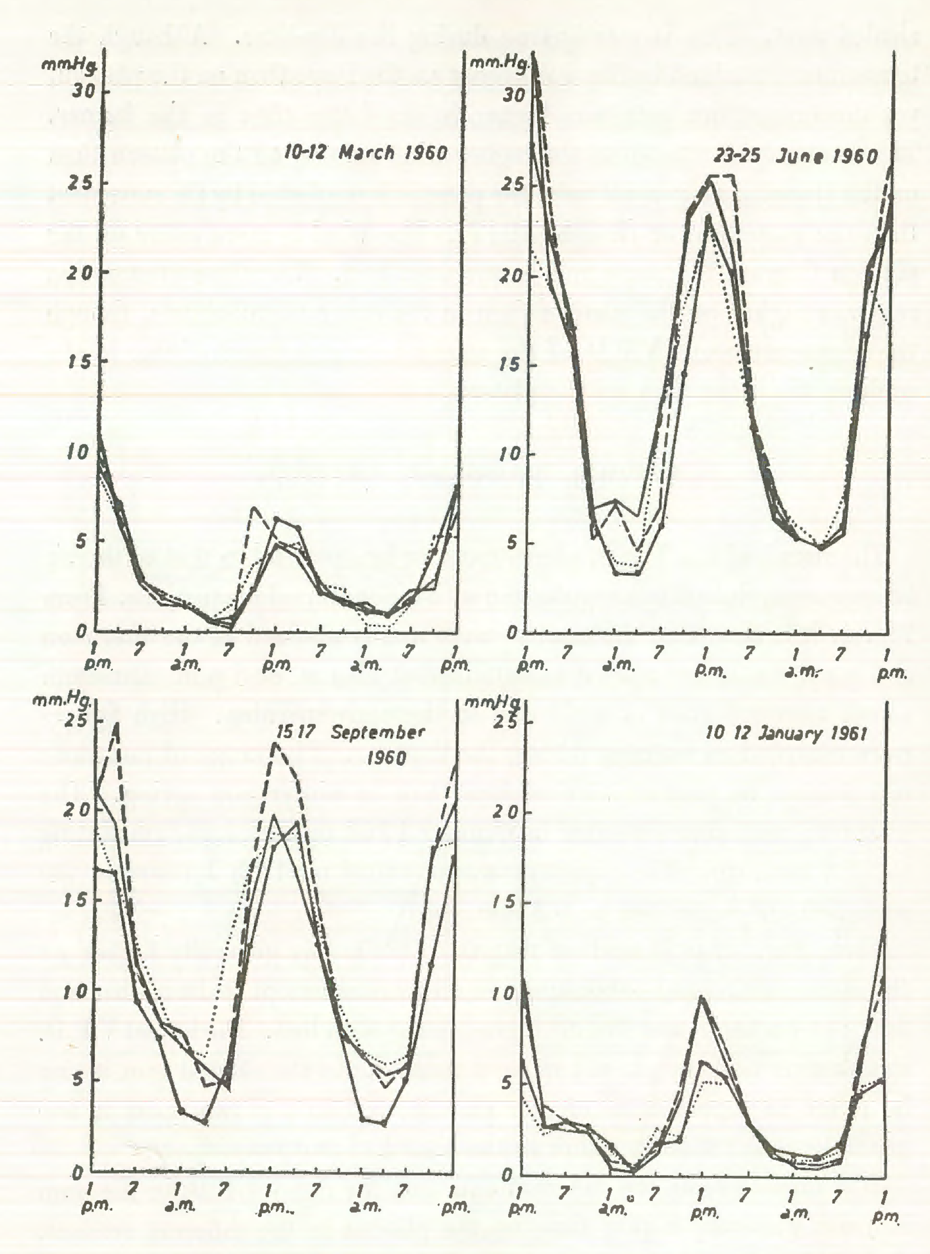


Fig. 4. Diurnal fluctuations in the vapour pressure deficit in the various microhabitats in four months representing the different seasons.

Plateau —•—•— Shade ......
Wadi bed ——— Slope - - - - -

relative humidity within the leafy frame-work of a desert plant has been proved; on the contrary in several instances, the humidity in the neighbourhood of transpiring leaves has shown a diminution. This phenomenon results from the fact that, on the one hand, the desert wind hinders any enrichment of the transpired water vapour about the transpiring organs, while on the other hand, the insolation reflected from the earth and also from the plants as heat favours an increase of temperature and a consequent lowering of relative humidity in proximity to the plants».

WIND VELOCITY

The seasonal variations did not show regular rhythm as the variations in other atmospheric factors. But, generally, it showed more or less regular daily fluctuations, being higher by day and lower during the night, particularly in dawntime. The fluctuations are of narrower range in summer than in other seasons.

The values of wind velocity in the four microhabitats showed a regular sequence in all the months (Fig. 5). The plateau exhibited the highest value, due to exposure, then the slope and the first terrace, while the shaded microhabitat, due to protection, showed the lowest value. The wind velocity in the last mentioned microhabitat was nearly zero in all months.

High wind velocity on the plateau has a supreme effect on the evaporating power of the atmosphere, causing evaporation to be the highest for all microhabitats. By this it masks the effect of the difference in temperature and V.P.D. in the various microhabitats. Low wind velocity in the shaded microhabitat was associated by a low evaporation rate.

SOIL TEMPERATURE

Soil temperature in the different spots is affected primarily by the degree of their exposure to sun. Malherbe (1948, p. 109) stated that for any given climate the land relief or slope, especially in undulating or mountainous country, has a very important effect on soil temperature.

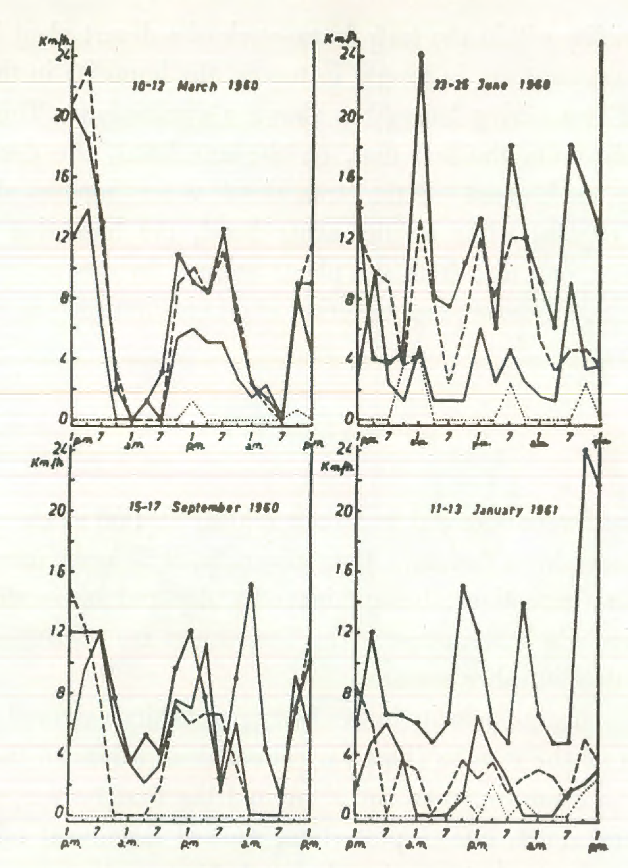


Fig. 5. Diurnal fluctuations in the wind velocity in the various microhabitats in four months representing the different seasons.

Plateau —·—·— Shade ......
Wadi bed ——— Slope -----

The plateau is exposed nearly all daytime to direct sunrays. Hence high temperature on the surface was observed in all seasons, though not higher than the wadi bed due to the compensating ventilation effect of wind. Also the direct heating of the wadi bed by sun is reinforced by heat from the neighbouring slopes. The soil temperature at 10 and 25 cm. depth in the plateau showed narrower range of daily fluctuations than the wadi bed in all the seasons except in March (Fig. 6). The lowest minimum temperature at 10 and 25 cm. depth in the different months,

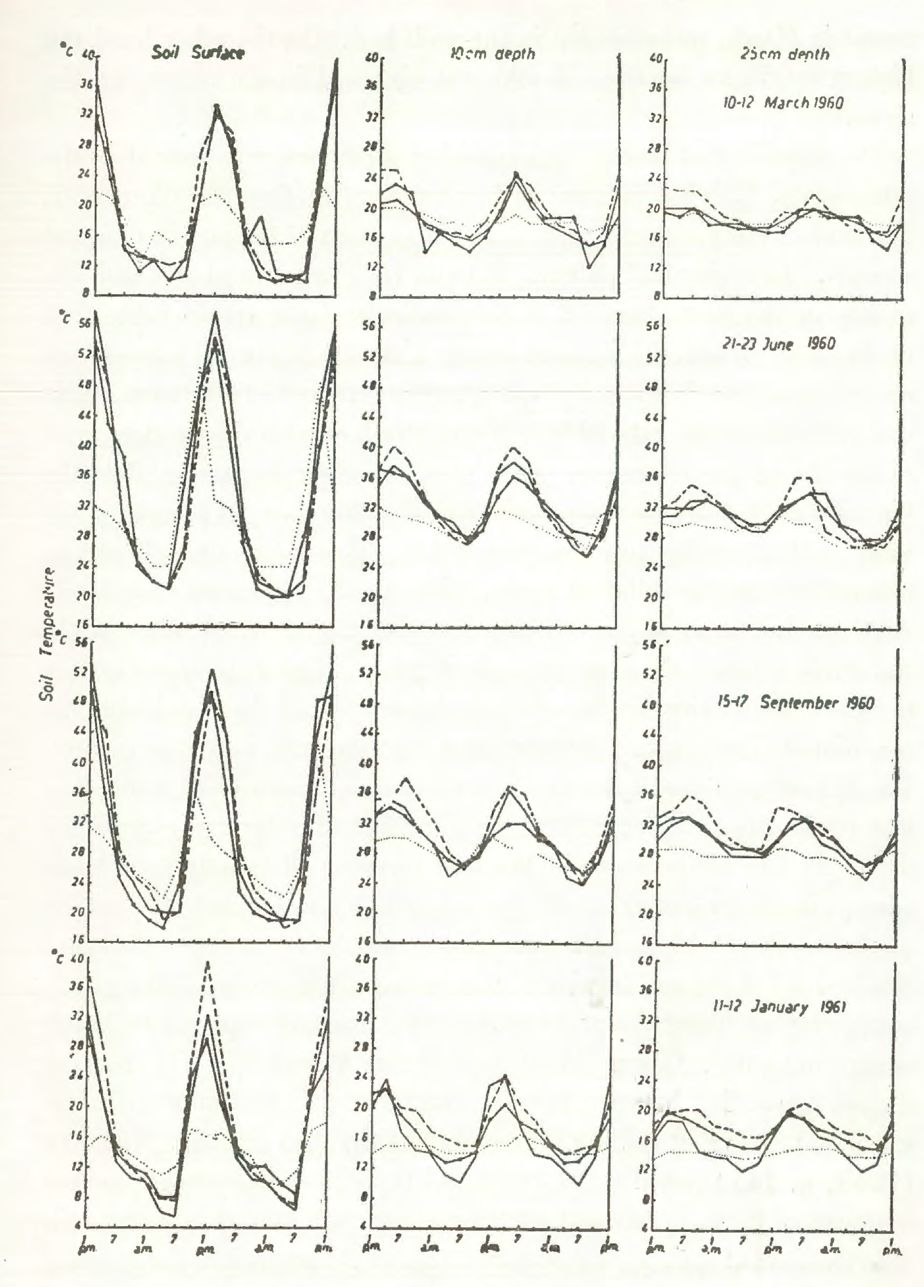


Fig. 6. Diurnal fluctuations in the soil temperature at different depths in the various microhabitats, in four months representing the different seasons.

Plateau —·—·— Shade ......
Wadi bed ——— Slope -----

except in March, was recorded in the wadi bed. On the other hand the highest maximum for these depths was observed in all months on the slope.

The slope is west facing, thus receiving direct sun rays later than the other spots. This led to lower surface temperature than the other spots. The surface temperature depends on the position of the sun in different seasons. In spring and autumn, the sun rises from direct east and sets exactly in the west, hence it is perpendicular for a considerable time to the slope surface. This causes greater elevation of the soil temperature on the slope than in the other spots, particularly in the afternoon. This did not hold on the 1st and last days of March records due to cloudiness of the sky in the afternoon. In winter, the slope surface exhibits the highest temperature by day especially in the afternoon, as the sun is too weak in the morning to cause remarkable difference in the soil surface temperature in the different spots. But, in the afternoon west facing slope receives more of the sun rays, causing higher temperature of the soil surface there than on any other spot. Higher temperature on the slope surface than on that of the first terrace or of the wadi bed in the morning in January may be attributed to difference in water content. The uppermost layer of the first terrace contains much more water than that of the slope. The resultant cooling effect of water causes lowering of the surface temperature in the first terrace. Relatively high water content in winter causes a wide diurnal variation in the soil temperature at the depths of 10 and 25 cm. This is attributed to the higher heat conductivity of the soil in winter than in any other season as the poorly conducting air filling the pores of the soil is partially replaced by better conducting water. Geiger (1959) quoted that Albrecht (1937) observed a close correlation between precipitation and soil heat conductivity. It was found that moist soil has higher conductivity than dry one. Malherbe (1948, p. 111) stated that a moist soil through the improved thermal conductivity between the soil particles conducts better than a dry soil.

In the shaded spot, a great temperature rise is observed in the morning at the soil surface as the spot is east facing. A continuous rise was observed till 10 a.m., followed by a slight increase or decrease towards 1 p.m., according to the season (Fig. 6). At sunset, the surface temperature

in the shaded spot showed only a slight decrease in all months in comparison to the sharp one occurring in the other spots.

CONCLUSIONS

The plateau is the most exposed microhabitat to wind, solar radiation and evaporation. The high evaporating power of the atmosphere minimises the efficiency of rainfall. This is one of the important factors which cause the sparcity and openness of the vegetation in this microhabitat.

The shaded microhabitat is the coolest of all microhabitats and shows the narrowest range of diurnal and seasonal variations of air temperature. The V.P.D., wind velocity and evaporation rate also shows the lowest values. Favourable environmental conditions prevail in this microhabitat and make the vegetation relatively rich and vigorous and the plant cover rather high (20%). Among these favourable conditions may be mentioned the low evaporating power of the atmosphere and protection from direct sunlight during the major part of the day.

The relatively low values of atmospheric evaporating factors in the shaded area have their great effect on the water expenditure of plants in this microhabitat. The transpiration rate of these plants, is considerably lower than those of plants exposed to direct sun.

In the wadi bed, the temperature exhibits wide diurnal and seasonal variations. The temperature is lower than on the slope, but higher than in the shaded area and the plateau. These variations are of wide range particularly in summer and winter, but of narrow range in spring and autumn. The V.P.D. in this microhabitat exhibits higher values than those in the plateau, though the plant cover is denser in the former than in the latter. This points out to the negligible effect of the plant cover on the V.P.D. This rise may be referred to the effect of wind which hinders the accumulation of the transpired water vapour round the plants and to the higher temperature. The wind velocity and evaporation rate are lower than in the plateau and the slope, but higher than in the shaded microhabitat. The relatively low wind velocity and evaporation rate in the wadi are some of the favourable conditions which

help in the appearance of a dense cover of vegetation with vigorous plants in the first terrace, and in lowering the rate of water expenditure from plants.

On the west facing slope, the air temperature is the highest in record except in June. The evaporation rate and wind velocity are lower than in the plateau, but higher than in the other microhabitats. The microclimatic conditions in this microhabitat together with the other unfavourable soil conditions afford the least chance for growth of plants.

Generally, in all months, the temperature becomes more or less the same in all microhabitats towards sunrise and sunset.

REFERENCES

Albrecht, E. (1937). Messgeräte d. Wärmehaushaltes and Erdoberfl. als Mitteld. bioklimat. *Forschung. Met.* Z. 54, 471-475.

Emberger, L. (1952). Report on the arid and semi-arid regions of North Western Africa. UNESCO/NS/AZ/89, Paris.

—— (1955). Afrique du Nord—Désert, Ecologie végétale, compte rendu de recherches, *Plant ecology reviews of research.* Paris, UNESCO, 219-249.

Geiger, R. (1959). The climate near the ground. English translation, by Miloroy N. Stewart and other. Harvard Univ. Press, Cambridge, Massach. esetts. 494 pp.

Kachkarov, D.N. and E.P. Korovine (1942). La vie dans les Déserts (trans. Th. Monod.) Payot, Paris.

Knight, R.C. (1917). The interrelation of stomatal aperture, leaf water content and transpiration rate. *Ann. Bot.* 31, 221-240.

Leda Dau (1960). Microclimas Des Restinges Dosudeste Do Brasil. 1. Restinga Interna de Cabo Frio. *Arquivos do Museu Nacional L.* 79-134.

Malherbe, I. Dev. (1948). Soil Fertility. Oxford reniu. Press 296 pp.

Marten, W. (1926). D. Strachlungsklima v. Potsdam. *Abb. Pr. Met.* 1-8, Nr. 4.

Oosting, H.J. and D.W. Hess (1956). Microclimate and a relic stand of *Tsuga canadensis* in the lower piedmont of North Carolina. *Ecol.* 37, 28-39.

Potzger, J.E. (1939). Microclimate and a notable case of its influence on a ridge in Central Indiana. *Ecol.* 30, 29-37.

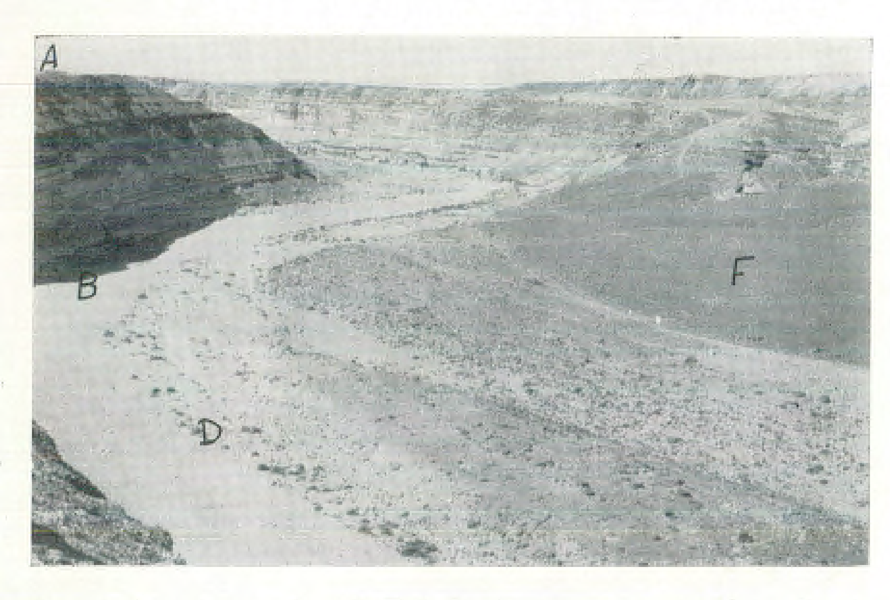
Schubert, J. (1928). D. Sonnenstrahl. im mittl. Norddeutchl nach. Messangen in Potsdam. *Met.* Z. 4, 1-16.

Walter, H. (1955). Die Klimadiagramme als Mittel zur Beurteilung der Klimaverhältnisse für Okologishe, Vegetation-Skundliche und landwirtsschaftliche Zwecke, *Beriche der Deutchen Botanischen Gesellschaft* 68, 331.

Walter, H. (1957). Klimadiagramme als Grundlage zur festatellung von Dürrezeiten. Wasser und Nahrung 1956-1957. 1, 8-11.

—— and H. Lieth (1959). Klimadiagramme Waltatlas, Gustav, Fisher Verlag. Jena.

Weaver, J.E. and F.E. Clements (1938). Plant Ecology. McGraw-Hill Book Co. Inc. New York and London. 601 pp.



General view of part of wadi Hoff showing the spots where microclimatic measurements were recorded.

A. Plateau. B. Shade.
D. First terrace. F. Slope.

PLUIES NUBIENNES AVANT LA CONSTRUCTION DU HAUT-BARRAGE

PAR

LOUIS-A. CHRISTOPHE

La climatologie est une science relativement récente fondée sur les expériences conduites dans des laboratoires spécialisés. Mais ces laboratoires, inamovibles par définition, sont construits en des lieux très précis : pour la République Arabe Unie, dont le territoire s'étend en longueur sur plus de mille kilomètres à vol d'oiseau, les centres d'études climatologiques se trouvent tous au nord du pays. Au sud, les instruments nécessaires font généralement défaut ; on se contente alors d'observations rudimentaires.

Ces remarques s'appliquent à la République soudanaise où les centres scientifiques sont, eux aussi, groupés autour de la capitale, Khartoum, soit, en ligne directe, à plus de sept cents kilomètres de la frontière septentrionale.

Ainsi le climat de la Nubie n'a jamais été étudié d'une façon scientifique. On lui a toujours appliqué les règles générales du climat désertique, telles qu'elles ont été établies pour les climats de la même latitude ou pour ceux des régions immédiatement voisines, compte tenu des quatre éléments suivants :

1. Le Tropique du Cancer traverse la Nubie égyptienne [1].

2. La rive occidentale du fleuve est bordée par un immense plateau désertique dont l'altitude varie peu jusqu'à l'Atlantique.

---

[1] Louis-A. Christophe, *La Nubie et le Tropique du Cancer,* dans *Bulletin de la Société de Géographie d'Egypte,* t. XXXIV, p. 75-80.

3. La rive orientale baigne le rebord du plateau arabique qui s'élève rapidement pour culminer à près de 2.000 mètres au-dessus de la Mer Rouge (Gebel Hamata, 1977 m., à la latitude d'Assouan).

4. La vallée du Nil nubien est très étroite; avant la construction du barrage d'Assouan, l'étendue cultivable ne dépassait pas cent mètres en largeur; les cultures s'étendaient tantôt sur une rive, tantôt sur l'autre, rarement sur les deux rives au même endroit[1].

Aussi m'a-t-il semblé utile de réunir toutes les informations qui permettent de caractériser, et aussi de différencier, le climat nubien, particulièrement en ce qui concerne la question des pluies. Ces informations sont celles des documents officiels, d'une part, et, d'autre part, des voyageurs qui se sont trouvés en Nubie à différentes époques de l'année et qui ont incidemment noté leurs observations.

*
* *

DOCUMENTS

A. — INFORMATIONS OFFICIELLES.

Climat Nubien

Au nord de la latitude 19° N, c'est une région désertique où, pendant toute l'année, prédominent les vents du nord secs et où la pluie est rare. En hiver, des vents violents, des tempêtes de sable et, occasionnellement, des averses frontales sont produites par l'arrivée d'une masse d'air froid à la suite d'une forte dépression méditerranéenne. Cette région subit les grandes variations de température, diurne et annuelle, qui sont caractéristiques du climat désertique.

(J. D. Tothill, *Agriculture in the Sudan,* Appendix I : The Climate of the Sudan, p. 67)

[1] Louis-A. Christophe, *Remarques sur l'économie de la Basse-Nubie égyptienne,* dans *Bulletin de la Société de Géographie d'Egypte,* t. XXXV, p. 77-128, en particulier p. 79-80.

Pluviosité dans le District d'Assouan

Moyenne de la pluviosité annuelle :	3 millimètres
avril-mai	2 millimètres
octobre-novembre	1 millimètre

Le maximum des précipitations enregistré dans cette région *pour un seul jour* est de 5 millimètres, 5 (mai 1935).

(Renseignements fournis par les services météorologiques de la R.A.U.)

*
* *

B. — OBSERVATIONS DES VOYAGEURS.

(classées d'après les saisons où elles ont été faites)

PRINTEMPS

17 mars 1965. Amada - Petite pluie d'orage (renseignement fourni par les ingénieurs français d'Amada).

21 mars 1965. Abou Simbel - Une petite pluie (quelques grosses gouttes) et de courte durée. (Renseignement fourni par le Dr. Anwar Choukry, en mission). Amada - Pluie d'orage à quatre ou cinq reprises pendant la journée; toute la surface du sol était mouillée (lettre des ingénieurs français d'Amada).

29 mars 1813. Kalabcha - Texte de Burckhardt (*Travels in Nubia,* p. 120) : « Il y eut une averse pendant la nuit, à la suite de laquelle mon guide et moi, nous prîmes un bon froid. La chaleur qui, durant tout mon voyage en remontant le fleuve, avait été très modérée pendant le jour, commençait à être forte et le changement soudain, occasionné par la pluie, d'une chaleur presque tropicale à un froid hivernal, affecta notre santé à tous les deux».

Burckhardt avait déjà interrogé les Nubiens au début de son voyage, et il avait noté les informations qu'il avait recueillies (*Travels in Nubia*, p. 10-11) : « [Entre Dehmit et Abou-Hor], j'ai traversé plusieurs lits de torrents. Quand les pluies sont abondantes sur le plateau [arabique], des torrents se précipitent occasionnellement dans le fleuve, mais ces pluies ne durent pas plus de deux jours. Ces torrents expliquent l'augmentation *temporaire* du Nil en Egypte, pendant l'hiver, quand le fleuve est à son niveau le plus bas. En Nubie, la pluie ne tombe jamais dans la vallée, excepté pour de rapides averses ; mais il y a dans les montagnes orientales, jusqu'à Suez, une saison pluvieuse régulière, qui produit d'abondantes récoltes d'herbes sauvages, et des pâtures pour le bétail des Bédouins qui habitent ces régions».

Printemps de 1833. Nubie - Texte de G. A. Hoskins (*A Winter in Egypt*, p. 341) : « J'ai vu pleuvoir à Thèbes pendant une heure ou deux, et même une fois en Nubie».

16 mai 1814. Taffa - Texte de Light (*Travels in Egypt, Nubia...*, p. 62) : « Je fus retenu à Taffa le 16 par le vent Khamsin qui changea dans la soirée en vent du nord et de l'ouest ; il transportait les sables du désert pendant des milles avec grande violence, à tel point qu'il obscurcissait le ciel et dissimulait les rochers près du bateau. Cela se poursuivit pendant deux heures, avec de grandes bourrasques de vent, du tonnerre et des éclairs et se calma enfin par un torrent d'eau. Mon guide, Osman, se réconfortait en psalmodiant des prières à Dieu et au Prophète, pendant que les matelots, en tremblant et en reculant devant la tempête, se cachaient au fond du bateau».

ÉTÉ

7 août 1962. Abou Simbel - Des voyageurs italiens et arméniens, de passage à Abou Simbel, sont surpris de constater que le ciel est complètement couvert de nuages et qu'il tombe par instants une petite pluie fine (sorte de bruine). (Renseignements fournis par M. Ara Boyadjian).

Août 1962. Abou Simbel - Un violent orage, accompagné d'une pluie diluvienne, s'abat sur Abou Simbel et toute la région au sud des temples, causant dans le hameau d'Ismaïlia, entre Ballana et Abou Simbel, l'effondrement de plusieurs maisons. Des ingénieurs suédois installés à Abou Simbel ont évalué à 25 mm. la hauteur des précipitations tombées ce jour-là. Quelques semaines plus tard, les pentes de la forteresse de Gebel Adda, sur la rive orientale, sont encore fortement ravinées et ces ravinements sont remplis d'une boue que le soleil a solidifiée ; dans la citadelle, des murs entiers se sont couchés et de nouveaux fragments de céramique apparaissent dans les rues nettoyées par les ruisselets (informations recueillies et constatations faites par moi-même).

30 Septembre 1965. Abou Simbel - La soirée avait été très orageuse. Pendant la nuit une pluie violente et d'assez longue durée est tombée sur le site. Les toits plats des maisons préfabriquées ont retenu l'eau et, par de nombreuses gouttières, cette eau s'est introduite à l'intérieur des édifices. Au petit matin le plateau présentait un aspect inaccoutumé : le sable était encore tout humide de l'eau qu'il avait bue et la luisance exceptionnelle des rochers épars témoignait de l'abondance des précipitations (renseignements recueillis *in situ* par moi-même).

HIVER

17 novembre 1964. Amada - Le vent de sable s'est levé la veille vers dix-huit heures. A 5 heures du matin l'orage a éclaté : éclairs, tonnerre. Une pluie très fine, et très courte, a réveillé tout le campement (renseignements fournis par les ingénieurs français d'Amada).

22 janvier 1965. Amada - Durant la journée, et à quatre ou cinq reprises, petite pluie suffisante pour mouiller les vêtements des travailleurs qui s'affairent au déplacement du temple. Pas de vent. (Renseignements fournis par les ingénieurs français d'Amada).

*
* *

L'étude de ces diverses informations appelle les remarques suivantes :

1. Il peut pleuvoir en Nubie et à des périodes différentes de l'année : fin janvier, fin mars, mi-mai, mi-août, fin septembre et mi-novembre.

2. Ces précipitations sont généralement très faibles. Elles peuvent toutefois tomber, en été, sous forme de véritables averses orageuses. Il faut peut-être établir un lien direct entre ces averses estivales et la crue du Nil.

3. Les pluies nubiennes sont très irrégulières ; elles ne se produisent pas chaque année ni, au cours d'un cycle d'années, à la même époque.

4. Les renseignements fournis par les voyageurs sont nécessairement incomplets. D'ordinaire, aucun touriste ne parcourt la Nubie pendant la saison chaude. D'autre part, les séjours nubiens sont généralement très courts et ne coïncident pas nécessairement avec des périodes de pluie. Enfin tous les voyageurs n'ont pas consigné leurs souvenirs ou publié le récit de leurs expériences.

5. Les observations faites l'ont été avant la construction du Haut-Barrage à une époque où le fleuve coulait normalement dans sa vallée étroite (voyageurs du XIXe siècle) ou encore ralentissait sa course dans le petit lac formé par les eaux de retenue du Barrage d'Assouan (période contemporaine).

6. Qu'en sera-t-il du climat nubien, et spécialement des conditions hygrométriques de la Nubie, compte tenu de l'énorme coefficient d'évaporation à cette latitude, lorsque le Haut-Barrage sera achevé et retiendra 157 milliards de m^3 d'eau et que le lac Nasser fixera ses rives (longueur : 500 kilomètres ; largeur moyenne : 10 kilomètres ; largeur maxima : 25 kilomètres) ?

NOTES ON TERENUTHIS-TARRÂNA

BY

OTTO MEINARDUS

To-day, Tarrâna is a small and insignificant town in the western part of the Nile Delta. Except for a few Egyptologists, who are interested in the ruins of Kôm Abû Billo, the former town of Terenuthis and its large necropolis, few Westerners had occasion to visit the town since the construction of the Cairo-Alexandria desert-road in 1936. Whereas, at one time, Terenuthis-Tarrâna was the site of a famous Ptolemaic Temple, an important episcopal see, a strategic commercial centre and a busy monastic dependency, to-day, the town has lost its religious prestige and economic importance.

The town of Tarrâna is situated on the western edge of the agricultural land of the Nile Delta in the Province of Beḥaira and the Marqas of Kôm Hamâdah, seven kilometers north of al-Khaṭâṭba and four kilometers south of Kafr Dâwûd. On the east, the town borders at the Rosetta Branch of the Nile, on the west, it lies on the Raîyâḥ al-Beḥaira. The main western agricultural road from Cairo (Muhammad ʿAlî Barrages) to Damanhûr passes west of Tarrâna. The town, therefore, is easily accessible either from Cairo or Alexandria. In addition, train and bus services connect the town with Cairo.

I. THE PRE-CHRISTIAN TOWN AND THE NECROPOLIS OF KÔM ABÛ BILLO.

There is archaeological evidence, that the site was inhabited during the XIXth Dynasty, for « older than any other object found is a block, probably of limestone, showing cartouches of Ramses II » [1]. Moreover,

[1] Griffith, F. Ll., *The Antiquities of Tell el Yahûdiyeh and Miscellaneous Work in Lower Egypt during the Years 1887-1888*. London, 1890, p. 60. Porter, B. and Moss, R.L.B., *Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts,*

two other stones with a cartouche of Necho II [1], and with a dedication to the Hermopolitan Toth seem to substantiate the habitation of the site during the XXVIIIth Dynasty [2].

During the Ptolemaic period, Terenuthis gained in importance, largely on account of the Temple of Hathor, which was begun by Ptolemy I Soter and completed by Ptolemy II Philadelphus [3]. « The enclosure of this temple with its chambers and the wall of the foundation are still partly traceable, but not a single block of stone remains» [4]. In Ptolemaic days, the site was known as *mafket,* and the goddess was called « Hathor of Mafket» [5], although Griffith suggests that the town may also have been called *μενελαου,* after Menelaus, the brother of Ptolemy I Soter [6]. The name Terenuti or Terenuthis has its origin in Renenutet or Ermuthis [7], the serpent-goddess and beautiful « Mistress of Provisions», who was also associated with Isis, and whose blessing extended to a good inundation of the Nile and the rejoicings which followed such a rise [8].

Reliefs, and Paintings, IV, Oxford, 1934, p. 67. PETERSEN, H., « The Earliest Christian Inscriptions in Egypt», *Classical Philology,* LIX, 3, 1964, p. 154.

(1) GRIFFITH, *op. cit.,* pp. 60-61. PETERSEN, *loc. cit.*

(2) GRIFFITH, *op. cit.,* p. 63.

(3) GRIFFITH, *op. cit.,* pp. 60-64. A XIXth century description of the ruined site of Kôm Abû Billo is contained in a letter written by F. Ll. Griffith to Amalia B. Edwards in February 1880, and published in *The Academy : A Weekly Review of Literature, Science and Art.* London, New Series, XXXIII, No. 826, March 3, 1888, p. 158.

(4) BOTHMER, B.V., « Ptolemaic Reliefs II : Temple Decorations of Ptolemy I Soter», *Bulletin of the Museum of Fine Arts,* Boston, L, 1952, pp. 51-52.

(5) BOTHMER, *loc. cit.*

(6) GRIFFITH, *op. cit.,* p. 64. « At least Strabo places a city of that name in this neighbourhood».

(7) LEIBOVITCH, J., « Gods of Agriculture and Welfare in Ancient Egypt», *Journal of Near Eastern Studies,* XII, 2, 1953, pp. 73-113. HERMANN, Alfred, « Die Deltastadt Terenuthis und ihre Göttin», *Mitt. d. deutsch. Inst. f. ägypt. Altertumskunde Kairo,* V, 1934, pp. 169-172.

(8) Sacrifices were offered to Renenutet on November 1 and August 1, and, accordingly, this month was known as the « Feast of Renenutet» (Pharmouti). HELCK, W. and OTTO, E., *Kleines Wörterbuch der Ägyptologie.* Wiesbaden, 1956, p. 304.

Furthermore, the importance of Terenuthis in Ptolemaic days is also attested by the fact that the Rosetta Branch of the Nile used to be known as the Terenuthian Nile [1]. However, neither the temple nor even the ruins of the temple dedicated to the serpent-goddess have been so far discovered.

During the Graeco-Roman Period, Terenuthis gained in economic significance and importance largely on account of the increased traffic between Alexandria, the former fishing-village of Rakote, and the Nile Valley. In addition, the town profited from the salt and soda, which was mined in the Nitrian Desert, the Wâdî 'n-Naṭrûn, and which was subsequently transported via Terenuthis to the north or to the south [2]. The ruins of this period, which are situated on the west bank of the Raîyâh al-Beḥaira, known as Kôm Abû Billo, have repeatedly attracted archaeologists. The only building, which towers above the extensive ruins is the sepulchral chapel, standing high on the northern part of the site [3].

In 1887-1888, F. Ll. Griffith discovered the Hathor Temple of Ptolemy I Soter [4], M. C. C. Edgar published several Greek inscriptions from Terenuthis [5], and M. H. Gauthier, who studied some funerary stelae from Kôm Abû Billo, remarked of the need for a large-scale

---

(1) PTOLEMAIOS, C., *Geographica.* IV, cap. 17. (Ed. C. Müller, Paris, 1901). TOUSSOUN, O., *Mémoires présentés à l'Institut d'Egypte.* Cairo, 1925. Vol. VIII, p. 192.

(2) A papyrus of 346 A.D. shows that at that time, Terenuthis was an important port for the transhipment of soda which was mined in the Wâdî 'n-Naṭrûn. WILCKEN, *Chrestomathie.* Pap. 332. London, II, p. 231. KEES, H., « Terenuthis», *Paulys Real-Encyclopädie der classischen Altertumswissenschaft.* Zweite Reihe, IX. Halbband, 1934, pp. 718-719. SMITH, William, *A Dictionary of Greek and Roman Geography.* London, 1873. Vol. II, p. 1129.

(3) CLARKE, S. and ENGELBACH, R., *Ancient Egyptian Masonry.* London, 1930, pp. 76 and 187. BADAWY, Alexander, « A Sepulchral Chapel of Graeco-Roman Times at Kom Abu Billo», *Journal of Near Eastern Studies,* XVI, 1, 1957, pp. 52-54. The measurements of the chapel are 6.75×4.59 m.

(4) GRIFFITH, *loc. cit.*

(5) EDGAR, M.C.C., « Greek Inscriptions from the Delta», *Annales du Service des Antiquités de l'Egypte,* XI, 1911, p. 2. « Some Greek Inscriptions», *Annales du Service des Antiquités de l'Egypte,* XV, 1915, pp. 105-112.

exploration of the site [1]. Hermann Junker, visiting Kôm Abû Billo in February 1928, investigated the site carefully and was deeply impressed by the vaste expanse of the ruins. He intimated that a systematic excavation would certainly reveal interesting discoveries of the Graeco-Roman period [2]. From February to April 1935, the University of Michigan excavated at various parts of the necropolis, especially near the southern edge of Kôm Abû Billo, where many funerary stelae were still found *in situ*. More than two hundred stelae were discovered, of which 194 were given to the University of Michigan [3], while others found their way either to the Egyptian Museum in Cairo [4], or to some other museums. Thus, for example, there is one stele in the Brooklyn Museum, [5] another stele in Copenhagen [6], and a further one in the Ikonenmuseum of Recklinghausen, Germany [7].

II. THE EPISCOPAL SEE OF TERENUTHIS.

In his article « The earliest Christian Inscriptions of Egypt », Hans Petersen has convincingly demonstrated that the part of the necropolis of Terenuthis, which was excavated by the University of Michigan, included both pre-Christian and Christian stelae. The coins, which were discovered, date the burials to the first half of the fourth century A. D.

(1) Gauthier, M.H., « Stèles funéraires de Kom Abou Bellou », *Annales du Service des Antiquités de l'Egypte,* XXI, 1921, pp. 203-210.

(2) Junker, Hermann, « Bericht über die nach dem Westdelta entsendete Expedition », *Denkschrift der Akademie der Wissenschaften,* Wien, LXVIII, 1928, 3, pp. 42-43.

(3) Hooper, F.A., *Funerary Stelae from Kom Abou Billou*. Ann Arbor, 1961.

(4) Aly, Zaki, « Some Funerary Stelae from Kom Abou Billou », *Bull. Soc. Royale d'Archéologie d'Alexandrie,* XXXVIII, 1949, pp. 55-88. « More Funerary Stelae from Kom Abou Bellou », *Bull. Soc. archéologique d'Alexandrie,* XL, 1953, pp. 101-150.

(5) Cooney, J.D., *Late Egyptian and Coptic Art*. Brooklyn, 1943, p. 17.

(6) Klausner, Th., « Studien zur Entstehungsgeschichte der christlichen Kunst, II », *Jahrbuch für Antike und Christentum,* II, 1959, p. 129.

(7) Wessel, K., *Koptische Kunst. Die Spätantike in Ägypten*. Recklinghausen, 1963, pp. 95-98.

and more specifically to the reigns of Constantine I and Constantine II [1]. Moreover, by comparing the *orantes* on the early Christian monuments of Rome with those of the stelae of Kôm Abû Billo, Petersen has pointed out some very definite similarities. « It is more than likely that the orantes of the Roman catacombs are related to those of Kom Abu Billo » [2]. This means, that we have archaeological evidence that by the first half of the fourth century, Christianity had penetrated into the Nile Delta. It is understandable that so strategically situated a town as Terenuthis would have accepted the New Faith more readily than some of the more remote and isolated villages and towns. The *Coptic Synaxarium* commemorates on the 27th of Abîb a certain Abamûn, a native of Terenuthis, who, desiring the crown of martyrdom, went before Arianus the Governor, and made his profession of faith. He was tortured and finally executed [3]. This incident confirms that by the latter part of the IIIrd century, some of the residents of Terenuthis were Christians. This fact is also attested by the *Acts of the Martyrs,* in which we read of Apatir, the son of Basileides, who, together with his sister Eirene, fled from Alexandria and went to Terenuthis, where they crossed the river to proceed to Babylon [4]. Apparently, Terenuthis was a safe place for Christians to flee to. Certainly, during the following centuries, the town gained a reputation as a haven for Christian refugees.

By the fourth century, the ancient commercial relations between the Wâdî 'n-Naṭrûn and Terenuthis were enriched by the traffic between the Desert Fathers of Scetis [5] and the Nile Delta. For that matter, the

(1) Petersen, *loc. cit.*

(2) Petersen, *op. cit.,* p. 166. The fact that the early Christian monuments of Rome show the *orantes* in frontal view rather than in profile, and that the frontal view is also found among the *orantes* of Kom Abu Billo, has led Petersen to conclude that the Christian art of Rome influenced some of the funerary stelae of Kom Abu Billo. Cf. Bonner, Campbell, « The Ship of the Soul on a Group of Grave-Stelae from Terenuthis », *Proceedings of the American Philosophical Society,* LXXXV, 1, 1941, pp. 84-91.

(3) Basset, R., « Le Synaxaire Arabe Jacobite », *Patr. Orient.* XVII, pp. 692-693.

(4) Hyvernat, H., *Les Actes des Martyrs de l'Egypte*. Paris, 1886, pp. 91 and 99.

(5) Evelyn White, H.G., *The Monasteries of the Wâdi 'n-Naṭrûn*. New York, 1932. Vol. II, pp. 141 ff.

foundation of St. Macarius was situated only 55 km. from Terenuthis, which was the nearest point in the Delta. In the *Paradise of the Fathers,* Palladius records that on one occasion St. Macarius the Egyptian went from Scetis to Therenuthum, and at eventide he came upon a certain place where there were some old bones and bodies of the dead, where he rested [1]. Tempted by the devils which dwelt there, St. Macarius overcame them all, so that they fled away ashamed [2]. As a commercial centre, Terenuthis also became the market-town for the monks of the Desert of Scetis, and the *Apophthegmata Patrum* relate that St. Macarius used to go there to sell the palmleaf-baskets, which he had made [3].

During the v[th] century, the monasteries of the Wâdî 'n-Naṭrûn were sacked by the Mazices, who advanced from the southerly oases of Farâfra and Bahrîyeh, and many of the monks escaped from the desert to Terenuthis [4], among whom were the famous monks Poemen and Anub with their brothers [5]. No doubt, Terenuthis provided a welcome place of protection, especially, since already in the latter part of the iv[th] century, the town had advanced to an episcopal see. Among the seven Egyptian bishops, who revolted against the violence of Theophilus, the 23rd Patriarch of Alexandria (384-412 A. D.), there is listed *Ιωάννης Τερνούθεος* [6], and the Paschal Epistle of Theophilus of the year 404 A. D. mentions « in Terenuthide Arsinthium» [7]. When in 431 A. D. two hundred bishops assembled for the IIIrd Oecumenical Council of Ephesus, the episcopal see of Terenuthis was represented by its bishop Eulogios [8].

(1) Probably a reference to the necropolis of Kôm Abû Billo.

(2) BUDGE, E.A.W., *The Paradise or Garden of the Holy Fathers.* London, 1907, Vol. II, p. 197.

(3) *Apophthegmata Patrum,* Macarius Aegyptius, XIII.

(4) BUTLER, Dom Cuthbert, *The Lausiac History of Palladius,* Cambridge, 1904. Vol. II, p. 189.

(5) *Apophthegmata Patrum,* Anub, I.

(6) De vita et excilio Ioannis Chrysostomi, MIGNE, *P.G.* XLVII, col. LIX, LXI. MUNIER, H., *Recueil des Listes Episcopales de l'Eglise Copte.* Cairo, 1943, p. 11. ERMONI, V., «Les Evêchés de l'Egypte Chrétienne», *Revue de l'Orient Chrétien,* Paris, V, 1900, p. 640.

(7) *Dict. d'hist. et géogr. ecclés.* IV, col. 762. MUNIER, *op. cit.*, p. 12.

(8) MANSI, *Acta conciliorum,* IV, 1124. MUNIER, *op. cit.*, p. 13.

Unfortunately, there are hardly any architectural remains of the Byzantine Terenuthis. However, speaking about the Ptolemaic Temple at Kôm Abû Billo, B. V. Bothmer remarks, that « several feet above the foundation of this wall is a tile pavement with small marble columns lying upon it. It is evident that we have here the site of successive churches, and the earliest of them was built of stone taken direct from the pagan temple, and built without any reworking ... It is evident that the town grew very rapidly in height in the Coptic period» [1]. Whether this church was the ancient cathedral or merely one of the numerous churches of Terenuthis, is, of course, impossible to determine.

The geographical proximity to the desert monasteries of the Wâdî 'n-Naṭrûn led the inhabitants to serve the monks. Thus, for example, we hear of a temporary *xenodochion,* which a certain Païsia established by transforming her house, which probably was situated at Terenuthis. Here, the monks were received and lodged when they came up from the desert [2]. Was this perhaps the first monastic dependency at Terenuthis?

In the vi[th] century, we hear of a further reference to Terenuthis as an established market-place for the products of the Desert Fathers. Abba Daniel, the famous ascete of Scetis and *hegoumenos* of the Monastery of St. Macarius [3], used to labour with his hands, and carried the baskets and mats made by him to Terenuthis for sale, and John Moschus (550-619 A. D.) [4], who visited Terenuthis, relates that here Abba Daniel was besought by a young man to pray that his wife might bear him a child. When a son was born to the couple, ill-natured persons alleged that Daniel was the real father [5]. On account of its proximity to the desert, Terenuthis continued to serve as a place of refuge for the periodically persecuted and oppressed Desert Fathers. Thus, at the time of the fifth sack of the Wâdî 'n-Naṭrûn monasteries, between 570 and 573 A. D.,

(1) BOTHMER, *op. cit.*, pp. 51-52.

(2) EVELYN-WHITE, *op. cit.*, p. 187.

(3) CLUGNET, L., *Vie et récits de l'Abbé Daniel le Scitiote.* Paris, 1901, p. 32, II, pp. 22 f.

(4) John MOSCHUS, *Pratum spirituale.* MIGNE, *P.G.* CXIV.

(5) Abba Daniel is commemorated in the Coptic Church on the 8th of Bashons (May 16).

which resulted in the complete destruction of the churches and monasteries of Scetis, the monks were scattered and several of them, among whom was Theodore of Alexandria, fled to Terenuthis (1).

III. TERENUTHIS-TARRÂNA DURING THE ISLAMIC ERA.

At the time of the Arab Conquest, Terenuthis had considerably increased in strategic importance, which led the Romans to defend the town against the cavalry of the Arab forces of ʿAmr ibn al-ʿAs. It was only natural that such a town, which served as the regular crossing-place of the Nile on the way to Alexandria, and, at the same time, as point of departure for the Wâdî 'n-Naṭrûn, was not to be surrendered without resistance. And, although the Romans suffered defeat, at least they saved their honour (2). Not very much later, the former battle-ground was transformed into a large welcoming stage, for we are informed, that there went out from the Wâdî 'n-Naṭrûn seventy thousand monks, each one having a staff in his hand, and they went to Terenuthis to salute ʿAmr ibn al-ʿAs on his return from Alexandria and to implore his protection for them and for their monasteries (3).

After Isaac, the future patriarch (686-689 A. D.), had run away from his parental home in order to enter the desert, he sought refuge in Terenuthis, so as to avoid the searches of his parents, who were looking for him in the desert (4). By this time, Terenuthis, as an important episcopal see, a monastic centre, and a trading town, must have enjoyed prosperity and status. Peter, a bishop of Terenuthis (Tarnût) is mentioned as having participated in the deliberations of the Synod, which assembled in 743 A.D. for the election of Mîkhâîl I, the 46th Patriarch of Alexandria (5),

(1) O'Leary, De Lacy, *The Saints of Egypt*. London, 1937, p. 122.

(2) Butler, Alfred, *The Arab Conquest of Egypt*. Oxford, 1902, p. 283. Lane-Poole, Stanley, *A History of Egypt in the Middle Ages*. London, 1925, p. 10.

(3) Quatremère, Et., *Mémoires géographiques et historiques sur l'Egypte*. Paris, 1811, vol. I, p. 464.

(4) Porcher, E., « Vie d'Isaac Patriarche d'Alexandrie de 686 à 689 », *Patr. Orient.* XI, pp. 314 and 386.

(5) Evetts, B.T.A., « The History of the Patriarchs of the Coptic Church », *Patr. Orient.* V, pp. 106-107.

and during the patriarchate of John IV (777-799 A.D.), the relics of St. Macarius, which were stolen shortly after his death, were returned from the town of Elmi (?) to the Monastery of St. Macarius. At Terenuthis (Tarnût), the relics were taken off the ship and then carried into the desert (1).

According to the xth century Arab geographer Ibn Hauqal (2), Terenuthis was situated on both banks of the Nile, and, in addition to a large mosque, the town had baths, well constructed markets, sugar mills and stores for grain and a large number of churches, which were ministered to by priests and monks. These buildings were, for the most part, constructed of brick, but by the xth century, a great part of the city was in ruin. Terenuthis had experienced the fury of the kitâma (3), a Berber tribe, who under the order of Abû'l-Kâsim, the eldest son of ʿUbaidallâh (934-946) (4), had camped there. In the xth century, Terenuthis was the residence of a governor, who had a regiment under his orders (5).

On more than one occasion, the destiny of the Christian community in Egypt was determined in Terenuthis. During the violent persecutions of the Faṭimid Caliph al-Hâkim (996-1021), Zakharîâh, the 64th Patriarch of Alexandria (1004-1032), after having been set free by al-Hâkim, went to the monasteries of the Wâdî 'n-Naṭrûn. At the same time, however, al-Hâkim commissioned an amîr from Miṣr (Cairo) and a group of workmen to go to the desert in order to demolish the churches and the desert monasteries. Yet, when they arrived at Tarnût (6), they changed their mind because of their fear of the Arabs (7). The monasteries

(1) « The Ethiopian Synaxar », *Patr. Orient.* IX, pp. 355 ff.

(2) Ibn Hauqal is known for the geography written in 977, which is a revision and extension of the *Masâlik wa'l-Mamâlik* of al-Istakhrî, who wrote in 951. Ed. De Goeje, M.J., Leiden, 1873, p. 90.

(3) Lane-Poole, *op. cit.*, p. 95.

(4) Lane-Poole, *op. cit.*, p. 97.

(5) Quatremère, *op. cit.*, I, pp. 353-355.

(6) Tarnût is the Arabic form of Terenuthis, a name which was used prior to that of Tarrâna. Cf. Quatremère, *loc. cit.*

(7) Aziz Suryal Atiya, Yassa ʿAbd al-Masîh, O.H.E. KHS-Burmester, *History of the Patriarchs of the Egyptian Church*. II, ii, Cairo, 1948, p. 200.

and the churches remained unmolested. Another brief reference to the town of Tarnût as a Coptic episcopal see is found in the journal of the xith century Arab traveller ʿAbd Allah ibn al-ʿAzîz ʿUbaid al-Bakhrî [1]. Idrîsî, the xiith century Arab geographer just mentions the small village of Tarnût, which was fairly well populated, and where there was a great deal of commerce [2]. By the xiith century, the new Arabic name of Tarrâna was well established. The town continued its prosperous conditions on account of its strategic situation, especially with regard to the Wâdî 'n-Naṭrûn. Khalîl ad-Dahirî (1189) informs us that the surroundings of Tarrâna were occupied by powerful tribes of Arab Bedouins, who were continually at war with each other. An old man, whose testimony he quotes, related that in a single engagement three thousand horsemen had been found dead in the field of battle [3]. In 1264, az-Zâhir Baybars I (1260-1277), the Mamluk Sultan, paid a visit to the monasteries of the Wâdî 'n-Naṭrûn, and on his way he stopped in Tarrâna [4]. For that matter, coming either from Cairo or from Alexandria, the harbour of Tarrâna provided the most convenient possibility for visiting the Coptic monasteries of the Wâdî 'n-Naṭrûn. When Benjamin II, the 82nd Patriarch of Alexandria (1327-1339), went to the Monastery of St. Bishoi on account of a disaster which had befallen that monastery, he too stayed overnight on his way in Tarrâna, travelling from there to the Monastery of St. Macarius and then north to the Monastery of St. Bishoi [5]. During the month of Ramadân 872 A.H. (March 1468), Sultan Malik Ashraf Abul Nasr Šerif ad-Dîn

(1) Quoted by Toussoun, O., *Etude sur le Wadi Natroun.* Alexandria, 1931, p. 35.

(2) Jaubert, A., *Géographie d'Edrisi.* Paris, 1836. Vol. I, p. 324. Dozy, R. and De Goeje, M.J., *Description de l'Afrique et de l'Espagne par Edrîzî.* Leyde, 1866, p. 190.

(3) Schefer, Charles, *Etude sur la Devise des Chemins de Babiloine.* Archives de l'Orient Latin, Paris, 1884, Vol. II, p. 99.

(4) Quatremère, Et., *Histoire des sultans mamlouks de l'Egypte.* London, 1837. Vol. I, p. 246. Sadeque, Syedah Fatima, *Baybars I of Egypt.* Pakistan, Oxford Press, 1956, p. 233.

(5) Evelyn-White, *op. cit.,* p. 395.

Qaitbâî spent several days at Tarrâna [1], afterwards, finding Bardbak, the simple inspector of this small town to be quite excessive, he promoted him and gave him the governorship of Safad [2].

Like the Patriarchs and Sultans, the mediaeval pilgrims to the monasteries of the Wâdî 'n-Naṭrûn also stopped at Tarrâna, which was known to the xvth century Franks as ' Alterana '. It seems that the Christian population of the town, which, by this time, had decreased to a very small minority, tried to offer its services to guide visitors across the desert to the monasteries. Josse van Ghistele (1481-1484) lodged in Tarrâna because one of his servants insisted that he should visit the fine Monastery of St. Macarius, which merited the trouble of being seen, and which happened to be « in the neighbourhood» [3].

A brief reference to Tarrâna is included in the diary of Sultan al-Ashraf (1501-1516), who in January 1515 travelled from Damanhûr via Nadjâla to Tarrâna, where he spent a day and a night [4]. The fact, that lodging facilities for travellers must have existed in Tarrâna, was an additional reason for government officials to stay there rather than in any of the neighbouring villages. By the xviith century, the number of European pilgrims and visitors to the monasteries of the Wâdî 'n-Naṭrûn had significantly increased [5], and the inhabitants of Tarrâna charged two piastres for each horse from the town to the Monastery of St. Macarius, and four piastres for each horseman, who accompanied the travellers to provide the necessary protection [6]. By this time, Tarrâna was the residence of the *cachef,* who was in charge of the desert-frontiers

(1) Ibn Iyas, *Histoire des Mamlouks Circassiens.* (Transl. Gaston Wiet) Cairo, 1945. Vol. II, p. 116. Also, Guest, A.R., «The Delta in the Middle Ages», *Journal of the Royal Asiatic Society,* 1912, p. 978.

(2) Ibn Iyas, *op. cit.,* p. 124.

(3) Saint-Génois, *Les Voyageurs Belges en XIIe-XVIIe siècle.* Brussels, n.d., pp. 169-170.

(4) Wiet, Gaston, *Journal d'un Bourgeois du Caire.* Cairo, 1945. Vol. I, p. 392.

(5) Meinardus, O., *Monks and Monasteries of the Egyptian Deserts.* Cairo, 1961, pp. 136-140, 183-192, 221-225, 251-255.

(6) Coppin, J., *Relation des Voyages faits dans la Turquie, la Thébaïde et la Barbarie.* London, 1720, p. 344.

of Libya [1]. Travelling through the Nile Delta was by no means always safe as Johann Michael Wansleben, the well-known theologian and historian who visited Egypt in 1672, testified. Sailing up the Western Branch of the Nile from Rosetta to Tarrâna, a trivial incident inspired the local Arabs of Tarrâna with a fantastic idea of his wealth, and a plot being laid to waylay and murder him, Wansleben was forced to abandon his project to visit the Coptic monasteries. However, during his stay in Tarrâna, he gathered some valuable information concerning the Wâdî 'n-Naṭrûn monasteries [2]. No doubt, Wansleben met the *hegoumenos* and some of the monks of the Dair as-Surîân, who until 1774 used to reside in Tarrâna [3], when the dependency was transferred to the nearby village of Atrîs.

About one hundred years after Wansleben's visit to Tarrâna, C.S. Sonnini de Manoncour (1777-1780) visited the town. Apparently, however, the situation in terms of safety for European visitors had not changed, and the account of the former French naval officer reflects in many ways a very similar picture to that given by Wansleben. « A *cachef* resided in Tarrâna, a town well enclosed and entirely built with mud-bricks as are all the villages of these districts. In the surroundings, one sees rubbish-heaps, vestiges of the ancient Terenuthis. The ruins are actually known in the country as Abou Bellou. The population of Tarrâna is wicked and ferocious, and the absence of the *cachef*, who was with the army, makes it still more dangerous. We were insulted and threatened there. They had heard there the news of my journey to the desert, and, according to the custom, they said that I had found treasures there. My boat was believed to be laden with them (treasures), and the inhabitants of Tarrâna formed a plan of taking them away during the

(1) Coppin, *loc. cit.*

(2) Vansleb, J.M., *Nouvelle Relation en forme de Journal d'un Voyage fait en Egypte en 1672 et 1673.* Paris, 1677, p. 227. The potential danger for Western travellers in the past is also attested by the experience of F.Ll. Griffith. An attack of the fellahin upon the bedouins had taken place. At the time of his visit in 1887, they were expecting vengeance at any moment. Griffith, *op. cit.*, p. 64.

(3) Monks of the Dair as-Surîân, *Sirat al-Anbâ Yuhannis Kame, tarîkh Dair as-Surîân.* Wâdî 'n-Naṭrûn, 1951, p. 55.

night. We informed our guards as some people were wandering about on the river-bank, but none of them dared to approach us. There was a Turk, who made very good gun-powder. This poor creature, who was young, had a white beard and a strangled voice from the effect of the fear which 'Alî Bey caused him, who, suspecting him of supplying powder to the Bedouins, whom he wished to destroy, ordered, that they should behead him, an order, which the tyrant, however, revoked for the moment and which also made a great impression» [1]. In 1789, Tarrâna became the inland port for the export of natron from the salt-lakes to Marseille, and thus its significance as a trading-centre increased considerably [2].

During the last decade of the xviii^th century, W.G. Brown visited Tarrâna and the ruins of Kôm Abû Billo « where are many columns and other considerable remains, which indicate the site of ancient structures». The buildings of Tarrâna were constructed chiefly of « unburned brick», but there were also some stone-buildings. The town belonged to Murad Bey, who, however, had entrusted the collection of the revenue there to Mr. Carlo Rosseti, a Venetian merchant. Mr. Rosseti, well-known throughout Egypt, was recently appointed consul-general of the Emperor of Germany [3], and the authority which he had obtained over the district of Tarrâna was almost equal to that exercised in former days by the *cachefs*. In order to control the shipments of natron from the Wâdî 'n-Naṭrûn to Tarrâna, and from there to the various nations of Europe, Mr. Rosseti had sent as his deputy Mr. Ferrari, his nephew, to reside in Tarrâna. In spite of the « Sclavonian» soldiers, who were under his authority for his protection, Mr. Ferrari died after a short time « not without suspicion of poison» [4]. Most of the travellers who passed through Tarrâna merely provided us with a brief mention of the name

(1) Sonnini, C.S., *Voyage dans la Haute et Basse Egypte.* Paris, An. VII de la Rep., Vol. II, pp. 227-228.

(2) Trécourt, J.B., *Mémoires sur l'Egypte.* Cairo, 1942, pp. 25, 91. Savary, *Lettres sur l'Egypte.* Paris, 1786, Vol. I, p. 73.

(3) This must have been Francis II.

(4) Browne, W.G., *Travels in Africa, Egypt and Syria from the year 1792-1798.* London, 1799, p. 36.

of the town [1] although Heinrich Brugsch, who went from Tarrâna to the Monastery of the Syrians, informs us that at the very end of the village there was a respectable house of European appearance, which was the summer-residence of Mr. Gibara, the leaseholder of the lakes of the Wâdî 'n-Naṭrûn [2].

Petersen is correct in stating that « the modern town of Tarrâna is not mentioned by most guidebook for travellers in Egypt» [3]. Yet, in Murray's *Handbook for Travellers in Lower and Upper Egypt,* Tarrâna is referred to as the first stop on the way to the desert monasteries of the Wâdî 'n-Naṭrûn, and the travellers are advised to contact « the headman of Tarrâna, a Copt, from whom it is well to get an introduction to the *qummus* of the Dair Macarius» [4].

In the XIX[th] century and until 1930, the Dair al-Barâmûs possessed a small dependency in Tarrâna, in addition to the dependency at Tûkh Dalaka [5]. In the Church of the Holy Virgin in Tarrâna, there are two lectionaries of 1858 [6] and 1898 [7]. The colophon of the 1858 manuscript indicates that it is the property of the « waqf of al-Barâmûs». In addition, I have seen a Ritual of 1851 with the following colophon : « Waqf of the Church of the Lady the Mistress at Akhît at-Tarrâna by the Qummus Girgis, Minister of the Church of the Lady the Mistress at

(1) JOLIFFE, T.R., *Lettres sur la Palestine, la Syrie et l'Egypte.* Paris, 1817, p. 296. CURZON, Robert, *Visits to the Monasteries in the Levant.* London, 1847, p. 92. WILKINSON, G., *Modern Egypt and Thebes.* London, 1843, vol. I, p. 387. TISCHENDORF, K., *Travels in the East.* London, 1847, p. 45. GRAUL, K., *Reise durch Egypten.* Leipzig, 1854, p. 242.

(2) BRUGSCH, Heinrich, *Reiseberichte aus Ägypten, 1853-1854.* Leipzig, 1855, p. 16.

(3) PETERSEN, *op. cit.,* 154.

(4) MURRAY, John, *Murray's Handbook for Travellers in Lower and Upper Egypt.* London, 1880, Vol. II, p. 306.

(5) MEINARDUS, *op. cit.,* p. 374.

(6) This lectionary measures 34 × 24 cm. with 22 lines. The text, which is in Coptic only, measures 24 × 16 cm.

(7) This lectionary measures 50 × 37 cm. with 28 lines. The text, which is in Coptic and Arabic, measures 27 (21 and 6) × 42 cm. The richly illuminated manuscript was written by ʿAbd al-Shahîd ʿAbd-al-Malik of Atrîs.

al-Barâmûs» [1]. The former Dependency of the Dair al-Barâmûs, which was situated in the southern part of the town, is now owned by Haggî Mîkhâîl, though the land, approximately thirty feddan, still belongs to the monastery. According to Abûnâ Samaʿan Saʿid, the village-priest of Tarrâna, the Dair al-Barâmûs also owned the house next to the church, where Cyril V, the 112th Patriarch of Alexandria (1874-1927), used to receive distinguished visitors whom he accompanied to the desert monastery [2]. Moreover, the villagers remember, that until the days of John XIX, the 113th Patriarch of Alexandria (1928-1942) [3], there was also a « novitiate» for the Dair al-Barâmûs in Tarrâna.

The parish of Tarrâna consists of altogether seven villages, including al-Khaṭâṭba, Kôm Hamâdah and Kafr Dâwûd. According to the parish-priest, approximately five hundred Christians belong to the parish. The Church of the Holy Virgin in Tarrâna, which belongs to the diocese of Beḥaira (Tanta), was rebuilt in 1960. The church has three altars, which are dedicated to St. Michael (north), the Holy Virgin (centre) and St. George (south). The XIX[th] century iconostasis is adorned with icons of St. Michael, the Holy Virgin, the Mystical Supper, St. Dimiana and her Forty Virgins and St. George. The Twelve Apostles on the top of the iconostasis are recent paintings of inferior quality. In the north-west corner of the church, there stands a *kouvouklion* with a modern icon of the Crucifixion. In the south-east corner of the church are the stairs that lead to the gallery. The present Christian cemetery, known as Baltûs is a small *kôm* which is situated south of Tarrâna [4]. The land south of this *kôm* belongs to the Department of Antiquities, though no excavations have taken place there as yet.

According to the 1960 census figures, there are 240 Christians in Tarrâna [5], though the village-priest states that only two or three Christian families are originally from Lower Egypt. Most Christians have come

(1) BURMESTER, O.H.E. KHS-, *The Egyptian or Coptic Church. A Detailed Description of her Liturgical Services.* Cairo, 1967, p. 316, n. 5.

(2) Cyril V used to be a monk at the Dair al-Barâmûs.

(3) John XIX used to be a monk at the Dair al-Barâmûs.

(4) JUNKER, *op. cit.,* p. 43.

(5) *Population Census of 1960* (Behaira Province). Cairo n.d. Vol. I, p. 100.

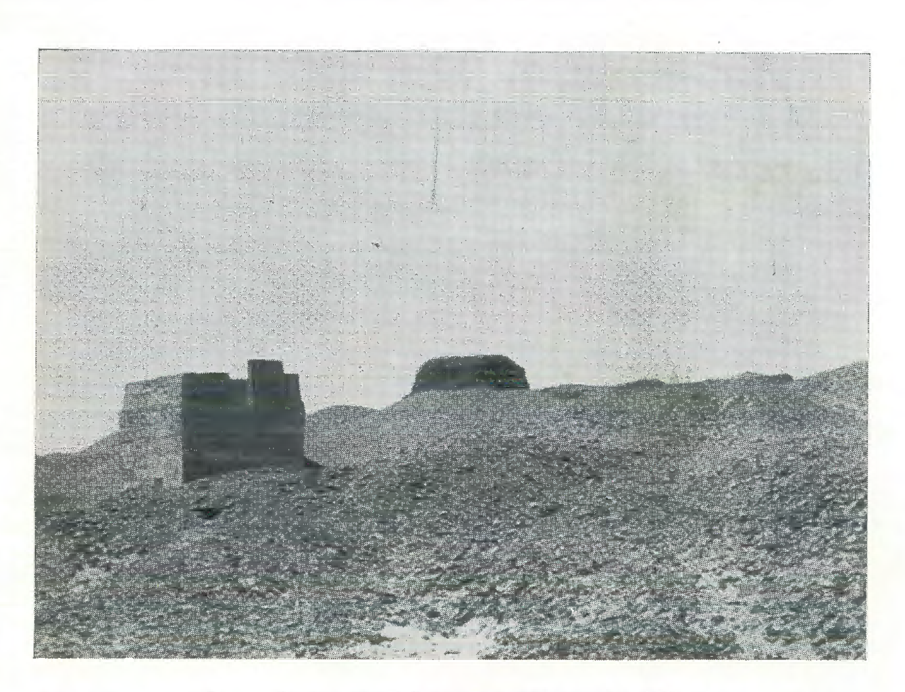
from Upper Egypt and settled in Tarrâna during the XIX[th] century. The most notable Christian family of Tarrâna is that of Ibrâhîm Bey Dâûd with a holding of approximately four hundred feddan.

The total population for Tarrâna is given as 4,020 [(1)], of whom 993 work in agriculture, 123 in mining, 40 in industry, 14 in construction, 42 in trade, 82 in transport, 86 in general services and 6 in other occupations [(2)]. The Muslim population amounts to 3,780 peoples. There are three mosques in Tarrâna, which are named after the families, who donated to the construction of the buildings. There is the Mosque of Issa, the Mosque of Mishadet, and the Mosque of Shiha. The Muslim cemetery is situated west of the town and north of the road which leads from the agricultural road to the town. The *qubba* of Shaikh ʿAbdullah, which is situated in the cemetery, is said to have been originally the tomb of a certain ʿAbd al-Malik.

(1) *Population Census of 1960* (Behaira Province). Cairo n.d. Vol. I, p. 72.
(2) *Ibid.*, p. 144.



A. — The extensive ruins of Kôm Abû Billo.



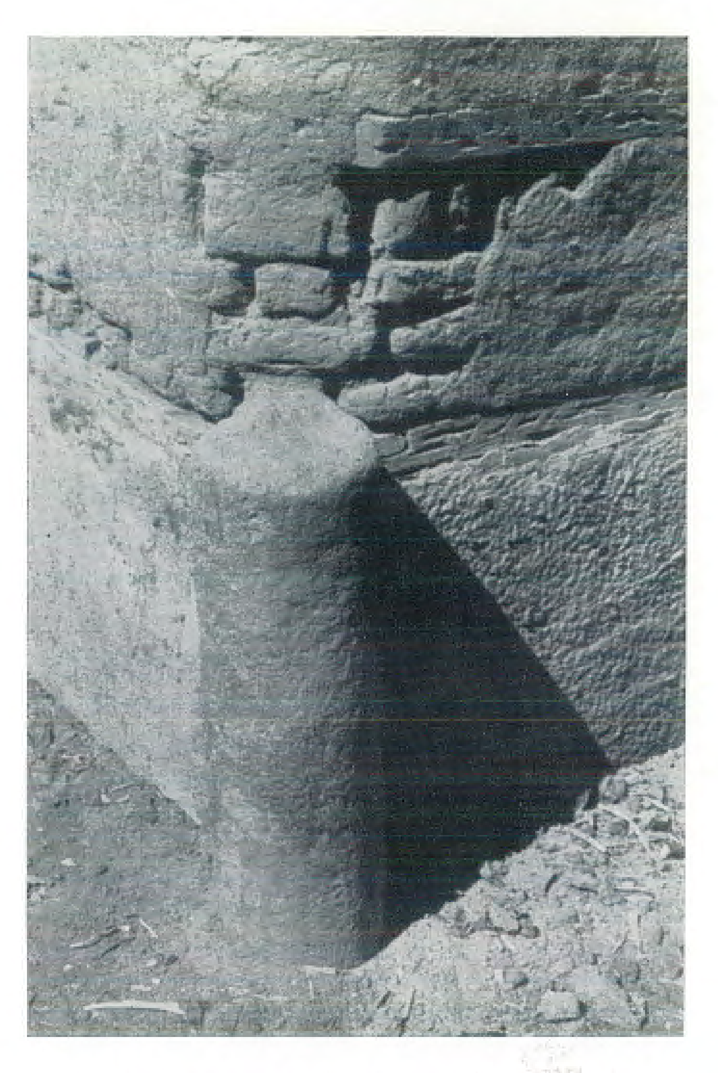
B. — The sepulchral chapel at Kôm Abû Billo.



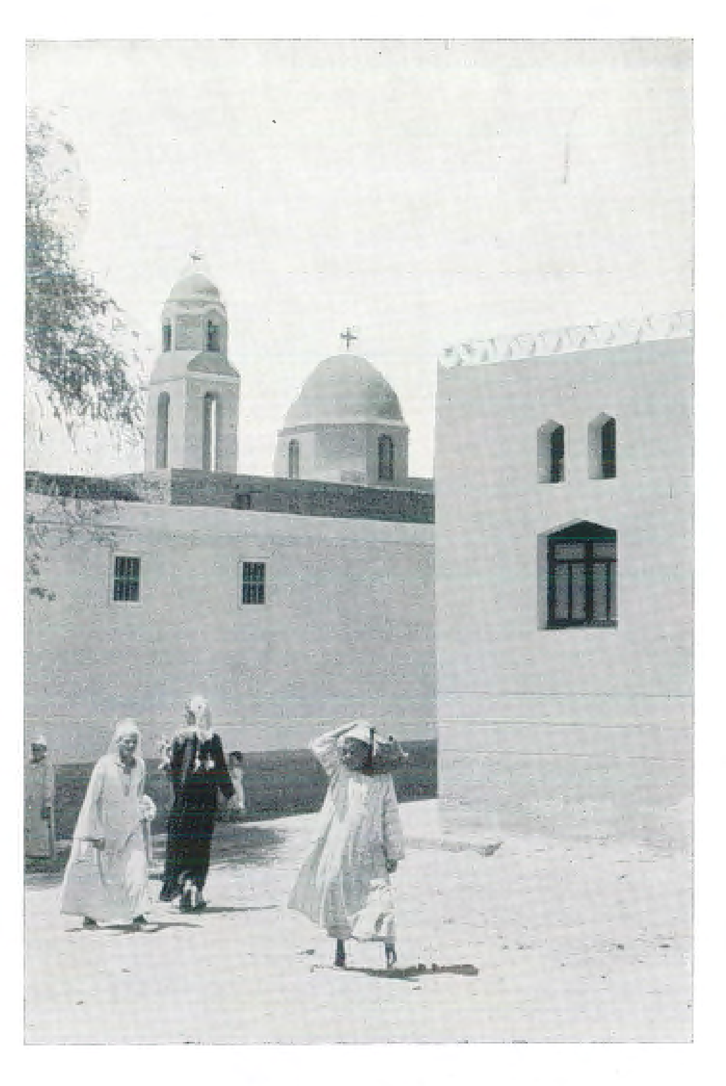
A. — View of Tarrâna from the west.



B. — Ancient millstone in Tarrâna near the Church of the Holy Virgin.



Ancient column in Tarrâna near the Church
of the Holy Virgin.



The Church of the Holy Virgin, Tarrâna.

CUESTA FEATURES

DEFINITION, CLASSIFICATION, AND THEIR DEVELOPMENT IN THE MAGHARA DISTRICT NORTHERN SINAI, U. A. R.

BY

HASSAN S. ABOU-EL-ENIN

The purpose of this paper is to deal with definition and general classification of cuesta features with a special reference to their development in the North-western part of the Gebel Maghara District, Northern Sinai. The examined area is of about 90 square miles (10 Miles long by 9 Miles wide), and enclosed between 30°, 38' to 30°, 42' North, and 33°, 17' to 33°, 25' East. It lies at about 150 Miles East of Asmailia (which stands at about the centre-point of the Suez Canal) and at about 90 Miles to the South-west of El-Arish.

Before reviewing the development of cuestas in the Maghara District, it is important to throw light on the definition of this term, general morphology of cuestas, basis on which they may be classified into different groups, and their significance in recent geomorphological studies.

Cuesta features in the Maghara District are found to be developed as the result of differential denudation of the alternating beds of the Chalky Limestone, the Flinty Limestone and Shales. They comprise a series of distinct forms, the descriptive terms of which namely cuestas, escarpments, scarps, dip-slopes, and cuesta-bridges have not been clearly defined.

The term « cuesta» was first introduced into geographical literature by Hill (1896), who assigned this Spanish word from New Mexico to « a structural plain so tilted that it has a perceptible sloping surface».

Davis (1899-1900) was the first to give it a precise definition, and he noted.

« I have, after waiting several years in hopes of finding a satisfactory word, advocated the general adoption of the cuesta ... to be more precise, cuesta is the name of the upland and the long gentle slope of such forms».

Hutton (1795), Gilbert (1877) and Powell (1876); had all described and referred to similar features having a steep inface slope and gentle dip slope in the opposite direction.

In 1939 Lobeck considered the ridges or uplands between the low-lands to be cuestas and he added that each cuesta has a steep inface and gentle back slope, down the dip of the beds.

Peel (1952, p. 97), has noted that the term « escarpment» is used by many British geomorphologists as equivalent to the term « cuesta», while American geomorphologists use the term « escarpment or scarp-slope » to refer only to the steep inface slope of the cuesta.

Cotton (1952) has however differentiated between a cuesta and a homoclinal ridge. He has noted that cuestas are necessarily broad and present greater contrast between escarpments and dip slopes than is found in typical homoclinal ridges. The dip slopes, indeed, are some-times so extensive and so nearly level that they have the appearance of plains, while near escarpment crests they may be regarded as plateaux.

Hassan Awad (1951 and 1960 p. 8-11) has distinguished two different regions of scarp land topography in Sinai, namely :

(*a*) The Cretaceous cuestas of Gebel El-Tih.

(*b*) The Eocene cuestas of Gebel El-Ugma.

His classification is based on the lithological variations of scarp-forming rocks, and has also noted that consequent streams « dip-type» are poorly developed, while obsequent streams « anti-dip type» have not much destroyed the magnificant scarps of El-Tih plateau.

From the foregoing discussion a cuesta comprises steep slope and long gentle dip slope developed on alternate resistant and less-resistant rock. « Scarp slope» or « escarpment» has been used to refer to the

steep inface slope of a cuesta, while cuesta refers to both the steep inface and the gentle back slope.

Accordingly an escarpment may not be a part of a cuesta. It is not so when there is a gentler slope above it, the true inclination of which is running opposite to the dip (i.e. anti-dip slope) (Fig. 1 B). Such examples have been recognised in several localities in the bottom of the Safa Valley about 2 Kilometres to the South-east of the Safa Camp. At each of these localities there is a very steep scarp slope (between 25°-40°) which declines in a direction opposite to the dip, and perpendicular to the strike, and the gentle back slope is an anti-dip type and does not support the formation of a true cuesta.

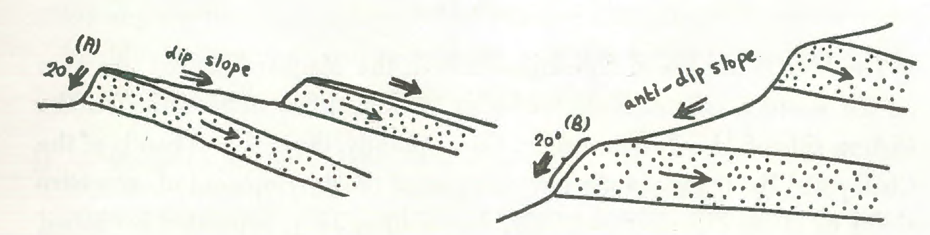
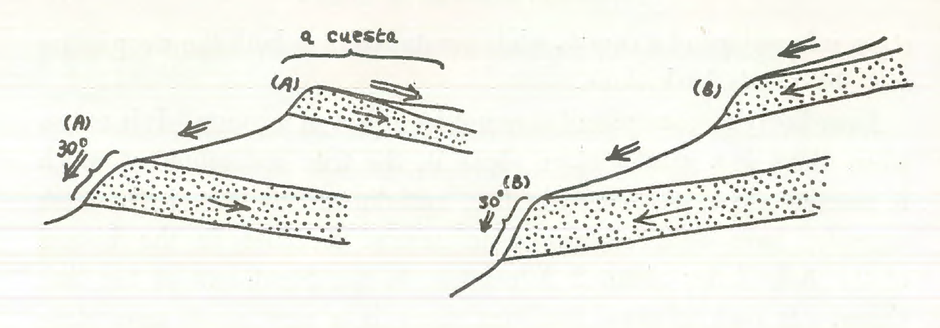


Fig. 1.

During the course of the present investigation in the Northern Sinai (U.A.R.), a further case has been recognised where a slope cannot be considered a scarp slope, though it displays the appropriate surface configuration. The main difference between this feature and an escarpment is structural, for while a scarp slope is a steep slope (steeper than the dip slope) facing the up-dip direction, the other feature is a steep slope, also running perpendicular to the strike, but facing the down-dip direction. Such features have been described by the present writer in the Upper Don Basin, South-west Yorkshire-England in 1964, and are referred to as dip slop-bluffs (Fig. 2 B).



(A) an escarpment.
(B) dip-slope-bluff.
30° surface slope.
dip.

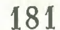
Fig. 2.

The best examples of dip-slope-bluffs in the Maghara District are seen on the western side of El-Melhi Valley, and in different localities on the eastern side of Abu Tarafia Valley. Consequently, the resistant bands of the Chalky and Marly limestones have supported the development of successive series of steep dip slope — bluffs, (more than 30°), separated by broad dip-type benches, the surface slopes of which run in accord with the dip.

PREVIOUS CLASSIFICATION OF CUESTA-FEATURES

Cuesta-features can be classified according either to the factors which influence the development of an individual cuesta, or to the variations in the pattern of cuesta-groups. They can therefore, be differentiated in the terms of either dimension, location, orientation, pattern of development in relation to the bounding streams, structure and frequency.

One of the earliest attempts is that of W.M. Davis (1915, p. 81), who proposed a classification based on the vertical and plan view of the cuesta, inferring its relationship to the geological structure. He referred the term « cuesta of overlapping order» to those cuestas which occur nearly above each other and their scarp slopes are separated by very short dip slopes. This particular type of development has been termed



a « double or two-fold cuesta» by Grabau (1920, p. 266), and as a « composite cuesta» by Doornkamp, (1962). Davis also referred to *wide-spaced order* cuestas are those having long dip slopes separated by escarpment, whereas *close-set order* cuestas are intermediate between the « overlapping» and the « wide-spaced order» type.

De Martonne (1922), and Schmithenner (1954), claimed that structural and erosional processes are mainly responsible for the development and pattern of cuestas. Derruau (1956) has distinguished the detailed differences in the form of an individual cuesta. More recently, Doornkamp (1962, p. 36) has adopted a dual classification based on the size and the extent of development of the cuesta together with its form in plan. Consequently, he has recognized the following groups :

I. — *Major Cuesta :*

(*a*) angular-nosed	(I) — with a marked escarpment at cuesta nose.
(*b*) blunt-nosed	(II) — without a marked escarpment at cuesta nose.
(*c*) round-nosed	

II. — *Minor Cuestas :*

(*a*) angular-nosed	(I) — with a marked escarpment at cuesta nose.
(*b*) blunt-nosed	(II) — without a marked escarpment at cuesta nose.
(*c*) round-nosed	

He has noted that his major cuestas are those which extend for more than 2 miles in the strike-direction, and that the minor ones are those which are less extensive.

However, during the course of the present investigation it is felt that there is still a need for a further classification by which cuesta features in the Maghara District may be satisfactorily distinguished.

A PROPOSED CLASSIFICATION

Since scarp and dip-slopes are the main criteria used to define a cuesta, it is convenient to suggest a classification based on the size and shape of a cuesta. In the field it is recognised that a cuesta feature is strongly pronounced in the surrounding relief when it has a steep scarp

slope and long, less steep dip-slope, while it is much less-marked in relief when it comprises a gentle scarp-slope, and a short dip-slope. Cuestas, therefore, have been simply classified according to their relative size and shape into « major», « intermediate», and « minor» ones : (Abou-El-Enin, 1962, p. 39 and 1964, p. 84).

1. The « major cuesta» is generally composed of strongly distinguished scarp and dip-slopes. The former is commonly a steep slope, i.e. more than 25°, is greater than 70 feet in height and more than 500 yards in length (Table 1). The dip-slope is usually more than 600 yards in width and more than 800 yards in length and has a declination considerably less than that of an escarpment.

2. The « intermediate cuesta» has an escarpment which commonly varies between 15°-25°. The dip slope is gentler than this, and varies between 300-600 yards in width, and between 400-800 yards in length.

3. The minor cuesta is the smallest in size. It may vary in form since it often appears as a smooth semi-rounded feature. However, its scarp-slope is commonly less than 15° and never exceeds 40 feet in height, while its dip-slope is less than 300 yards in width, and has a surface slope of more than 1° but less than that of the scarp-slope (Table 1).

TABLE 1

Relative extent of major, intermediate, and minor cuestas in the Maghara District.

DIVISION OF CUESTAS	SCARP SLOPE			DIP SLOPE		
	COMMON HIGHT (FEET)	COMMON LENGTH (YARDS)	COMMON STEEPNESS (DEGREES)	WIDTH (YARDS)	LENGTH (YARDS)	STEEPNESS (DEGREES)
1. Major...........	> 70	> 500	$> 25°$	> 600	800	$> 1°$
2. Intermediate......	between 40-70	between 300-400	between 15°-25° often	between 300-600	between 400-800	$> 1°$
3. Minor..........	< 40	< 300	$< 15°$	< 300	< 400	$> 1°$

It should be noted that it does not always follow that a major cuesta has a steep scarp-slope, nor that a major cuesta has a gentle scarp-slope, for in some cases a major cuesta may incorporate a gentle scarp slope, and a minor one may perhaps include a steep scarp-slope.

This proposed classification is only claimed to be valid in the Maghara District, but it may be applied to cuestas in other areas, with some modification. This is due of course to the fact that there is a marked difference in scale between cuestas developed in different regions. For instance, a major cuesta in the Maghara District has a dip slope of about 800 yards in length, but the largest one, (i.e. Dobiel El-Safa Cuesta, to the north of the Safa Camp) has a longitudinal extent of nearly 5 miles and a transverse extent [1] of about 4 miles. Those described by W.M. Davis (1898, p. 134) as young cuestas developed on the coastal plain of Alabama were about 120 miles long, from the foot of the escarpment to the foot of the dip slope.

An attempt has been made (Fig. 5 and 6) to map cuestas in the Maghara District according to their size and to scarp-forming rocks, in order to find out the relationship between the shape of cuestas in relation to the underlying structure. Furthermore, it is found that scarp-slopes of major, intermediate and minor cuestas vary from one to another, since they are mainly determined by the following factors :

1. The absolute and relative thickness of the scarp-forming rocks.

2. The absolute and relative resistance of the scarp-forming rocks.

3. The amount of dip.

4. The rate and depth of incision of the surrounding vales.

5. The origin of the cuesta-feature. For instance if the minor cuesta is developed as a result of the etching out of vales into less-resistant rock, it often has a gentle scarp slope. But a minor cuesta may have a steep scarp slope where it is formed by faulting or by deeply incised valleys.

[1] The term « transverse extent» refers to the distance between cuesta's flanks.

6. The stage of development.

It is convenient, therefore, to discuss the distribution of these different groups of cuestas in the Maghara District, Northern Sinai, and the factors thought to influence their initial and subsequent development.

DISTRIBUTION OF CUESTAS

IN THE MAGHARA DISTRICT—NORTHERN SINAI

Due to the fact that cuestas are structurally controlled-features it is important to throw light on the geology of the Maghara District. It will be possible therefore to understand the close relationship between surface forms (including cuestas), and the underlying geology.

The area under consideration which is generally composed of mountains forms an ellipse about 25 miles long by 15 miles wide, the long axis running SW-NE. On the average they reach 300-600 metres, and the heighest point Shusht el-Maghara, attains 735 metres (Arkell, 1956 p. 291).

In the Maghara District, Jurassic forms the complete and thickest Jurassic exposure in U.A.R. (Moon and Sadek, 1921, and R. Said, 1962, p. 230). The oldest rocks in the area are the Coal-Measures which are, in turn, restricted to the Bathonian Stage (Middle Jurassic), and examination of their lithological characteristic indicate that they are lagoonal and/or delatic facies. They are composed of two beds of Coal (vary from 1 to 1,30 metres in thickness), separated by shale bands, with intercalations of marls, outcropping in the vicinity of Shusht el-Maghara (Fig. 3).

The Coal-Measures and the Marly Limestone are capped by a Flinty Limestone which is a useful marker of the contact between this Stage and the overlying Callovian Stage (Arkell, 1956 and Farag, 1947). The geological formation of the latter is mainly composed of Shales, Marls, and Chalky Limestones, and are of about 350 metres in thickness (Fig. 4). The area is dissected by Wadies filled with unconsolidated or loosely unconsolidated sediments of Pleistocene and Recent in age.

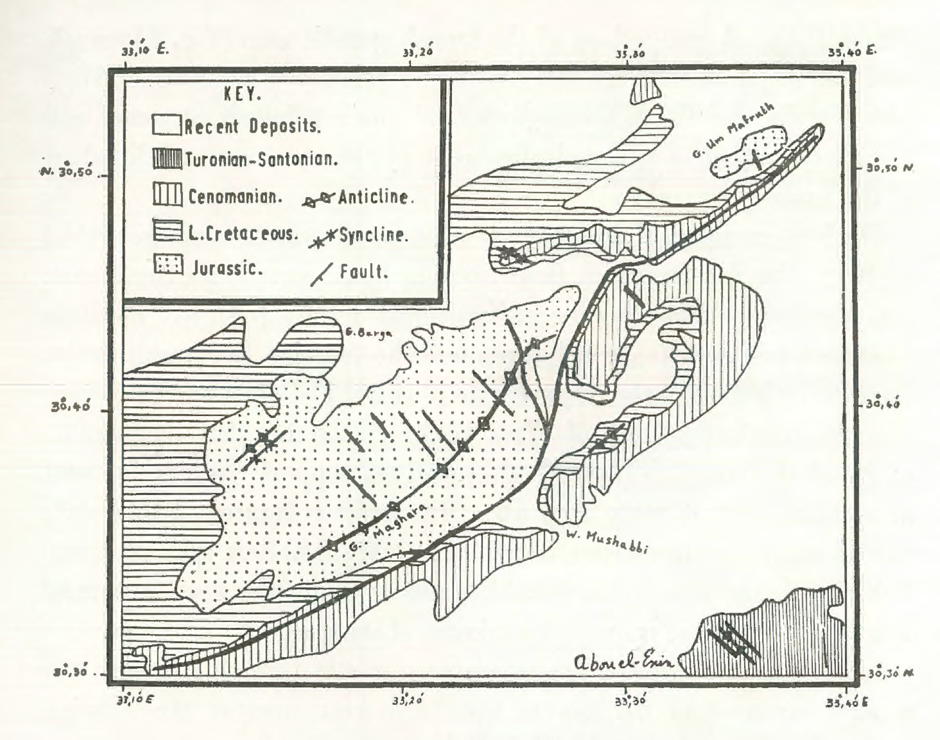


Fig. 3. — Geological Map of Gebel Maghara.

Structural contours indicate that all the above mentioned rocks are folded into asymmetric anticline with an axis striking approximately North-East. The north-western flank of this dome on which the area under investigation is located, dips at an angle of 10°-20°. (Fig. 3 and 4). The south-eastern flank dips steeply, and in parts, approaching verticality, as a result of a major fault which throws to the South-East bringing in Cretaceous strata on that side. The throw of this fault is estimated at 800 metres. The strata, particularly on the North-western flank are further dissected by faults which throws ranging from a few metres up to 100 metres, and to a less extent by strike faults with minor displacements (Fig. 4).

A. — Major Cuestas.

The major cuestas in the Maghara District are characterized by wide and generally steep scarp-slopes and very long and gentle dip-slopes.

(PLATE I, A). A comparison of the morphogenetic map (Fig. 5) reveals that the major cuestas are located on the primary watersheds of Wadi Abu Tarafia and Wadi El-Maghara and their tributary streams, and are all controlled in size and alignment by the structure and lithology of the underlying rocks.

The best examples of this group of cuestas occur on the main watershed of Wadi Abu Tarafia, which flows from the South-west to the North-east, and the sub-parallel South-east-North-west wadies (i.e., W. El-Morra El-Dobiel, and El-Safa), which drain into the Masajed El-Marahil Basin. Field investigation of the major cuesta of Gebel El-Dobiel on the eastern primary interfluvial crest of Wadi El-Safa, indicates that its scarp is of the Marly limestone (Lm. 6) which in turn support the development of wall-like scarp of more than 40°. The latter is transected by deeply incised wadies of the upper tributaries of Wadi-El-Safa and Wadi El-Dobiel. Occurrence of the NW-SE faults facilitate the deep cutting of the wadies along the geological weakness of the scarps.

Dip-slopes of El-Dobiel cuesta are very gentle (2°-6°) following the general direction of the dip to the North-west towards the Masajed Basin. The deep cutting of wadi El-Dobiel makes it excavate intermediate cuestas extending on the dip slopes and composed of the overlying Chalky Limestone bands (Ch. 1). At the foot of the dip-slope of El-Dobiel Cuesta, other minor Chalky Limestone bands (Ch. 3) often give rise to a close adjustment of micro-surface forms to structure. The thin shale outcrops are etched out as shallow broad wadies and minor cuesta-features, as those at the southern marginal extension of the Masajed Basin are well developed (Fig. 5 and 6).

The largest cuesta in the Maghara District is that of Gebel El-Shiek Hamid, which has a horse-shoe shaped escarpment and lies 3 kms. to the north of Bir El-Maghara. The scarp slope is developed on the Chalky Limestone (Ch. 1) and appears as a wall like features of more than 40°, and extends about 7 kms. from west to east. The dip slope is gentle and extends about 5 kilometres from the cuesta crests to its foot with an average slope of about 2°. On the dip-slope, a series of intermediate and minor cuesta is developed as a result of the excavation of strike and dip wadies along the shale bands in the Chalky Limestone Series.

GEOLOGICAL MAP OF THE MAGHARA DISTRICT

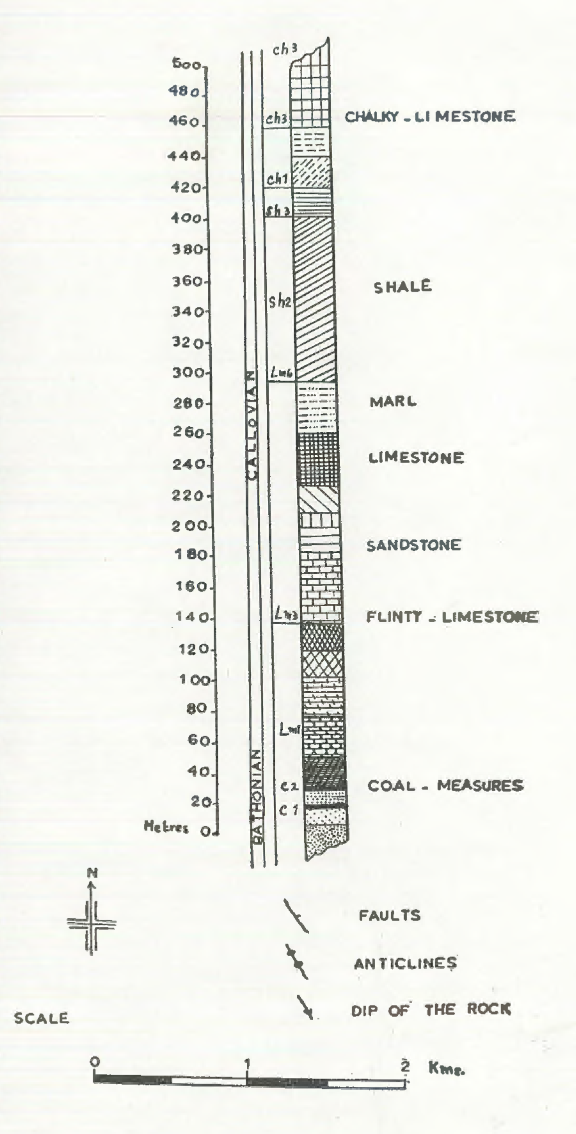


Fig. 4.

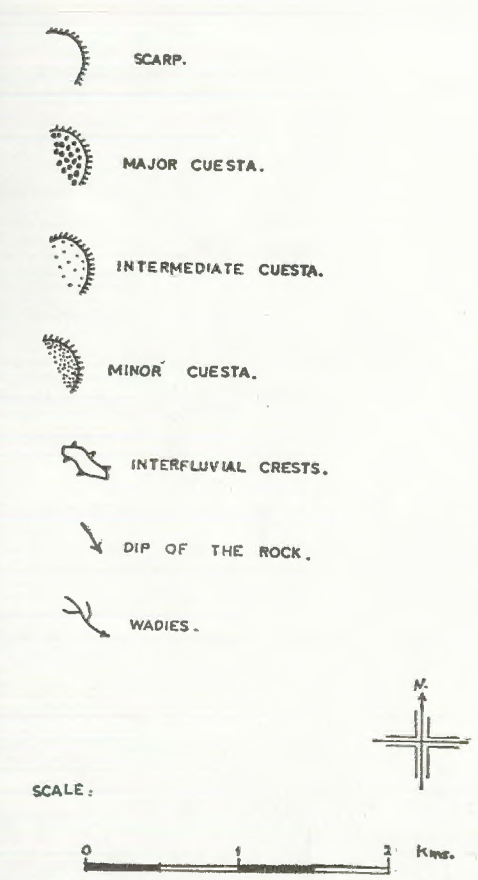

CLASSIFICATION OF CUESTAS ACCORDING TO THEIR SIZE.
SCARP.
MAJOR CUESTA.
INTERMEDIATE CUESTA.
MINOR CUESTA.
INTERFLUVIAL CRESTS.
DIP OF THE ROCK.
WADIES.
N.
SCALE:
0
1
2 Kms.
MASAJED BASIN
W. HARANIL
W. KHARIEK
W. MORRA
W. EL-SAFA
W. DOBIEL
W. UM-SIALILA
G. DOBIEL SAFA
SAFA CAMP
W. SAFA
W. EL-MELHI
W. EL-SAMER
W. ABU-TARAFIA
G. SHEIKH HAMID
W. MAGHARA
BIR MAGHARA
SHUSHT EL-MAGHARA

Fig. 5.



SCARP_FORMING ROCKS

SCARPS UNRELATED TO CUESTAS.

SCARP OF CUESTA.

CHALKY LIMESTONE.

MARLY - LIMESTONE.

FLINTY - LIMESTONE.

SANDY - LIMESTONE.

OOLITIC LIMESTONE.

THICK BANDS OF LIMESTONE

LIMESTONE BANDS "upper bajocian..."

MAJOR INTERFLUVIAL CRSTS.

DRY VALLIES "wadies."

DIP OF THE ROCK.

SCALE.

0 1 2 K.M.

Fig. 6.

Within the Maghara District, pattern of major cuestas is equally determined by the underlying structure. They are developed on the more resistant bands of the Bathonian and Callovian Series, (i.e. the Sandy limestones (Lm. 1), the Marly limestones (Lm. 6), and the Chalky limestones (Ch. 1). NW-SE faults facilitate the separation of cuestas scarps as a result of the deep down cutting of the wadies.

B. — Intermediate Cuestas.

This group of cuestas in the Maghara District comprises the same morphographic appearance of those of the major ones, but they are small in extent and size. The scarp slopes of intermediate cuestas are often of about 15° and between 30-50 feet in height. Dip slopes never exceed 800 yards long, and the distance between the cuesta's flanks is between 300-600 feet.

Field investigation indicates that this group of cuestas are mainly developed on :

(*a*) The primary watersheds of the upper part of Wadi Abu-Tarafia and the upper heads of Wadi El-Safa, where major cuestas (600 feet in level) are divided into intermediate ones as a result of faulting and cutting of ridges by the deeply incised wadies.

(*b*) The secondary watersheds of Wadi El-Maghara, Wadi Abu-Tarafia, Wadi-Khamashia, Wadi El-Safa, Wadi El-Melhi and Wadi El-Ragabia.

(*c*) The dip slopes of the major cuestas, as a result of etching out of less-resistant rocks by subsequent or strike Wadies.

This case is well developed on the dip slopes of Abu-Tarafia's Cuesta, and El-Dobiel's Cuesta. (Fig. 5, 6).

A comparison between the geological map (Fig. 4), and the geomorphogenetic map of the Maghara District (Fig. 5), shows a clear accordance between these intermediate cuestas and the underlying geology. Their pattern is again influenced by the relative thickness and resistance of scarp-forming rocks, by the rate of the incision of the major Wadies

and their tributaries, by the folding and faulting of the rocks and by their location on different parts of the limbs of the Maghara Dome. On the eastern valley side of Wadi Abu-Tarafia, this group of cuestas are mainly developed on both bands of Limestone (C 1), and the Olitic-Limestone (C 2), which are overlying the upper Bajocian Limestones. While on the Western valley side of Wadi-Khamashia and within the upper part of Wadi El-Safa, they are related to the Flinty Limestone (Lm. 3). Six Kilometres to the North-east of the Safa Camp, intermediate cuestas are in turn, developed on the Marly Limestone (Lm. 6).

The best examples of intermediate cuestas are those developed within the middle part of El-Melhi Valley to the North-west of El-Melhi Camp (Pl. I, B and II, A). Here they are mainly related to the Sandy Limestone (Lm. 1). They appear as a series of overlapping cuestas dipping to the West and South-west. As a result of relative resistance of the rocks, hard limestone bands support scarp-forming rocks, while the less-resistant bands are excavated by shallow wadies. Evidence of differential erosion has been observed along the composite-step-like scarp (Pl. II, A).

C. — Minor Cuestas.

This group of cuestas in the Maghara District refers to very subdued features which suffered extensive modification, and are now standing as low semi-rounded hills. They are of very smooth slopes, and since their scarpes rarely exceed 10° in steepness and 10 feet in hight, it is often difficult to determine the dip-slope of some of these cuestas in the field.

Within the Maghara District minor cuestas have been observed in different localities, particularly on :

(*a*) The major watershed of Wadi El-Maghara and Wadi Abu-Tarafia, as a result of the splitting of major and intermediate cuestas by N.W.-S.E. faults.

(*b*) The dip-slopes of both major and intermediate cuestas, as a result of the deep down cutting of the dip and strike dry wadies, in the less-resistant rocks.

(*c*) The valley sides as they do occur on the Eastern valley side of Wadi-El-Melhi and in some other places particularly when structural rock benches are slightly dissected by shallow vales.

(*d*) The marginal boundaries of the internal basin. In the field the best examples of this group of cuesta have been observed on the Southern boundaries of El-Masajed Basin. They comprise a series of cuestas which extends more than 8 kilometres from Wadi El-Sheikh Hamid in the East to Wadi El Kharik to the West. All cuestas in these localities are developed on the Chalky bands (Ch. 3), which dip to the North-west, representing the foot of the western limb of the Maghara Dome.

Field investigation reveals the development of other series of minor cuestas within the upper part of Wadi Om-Kotaifat (3 kilometres to the South-east of Bir El-Maghara). Here they are related to the resistant limestone (C 1), of the Bathonian Age and the Marly Limestone (Lm. 6), and the Chalky Limestone (Ch. 1) of the Callovian Age (Fig. 6).

INITIATION OF CUESTAS AND THEIR SUBSEQUENT MODIFICATION IN THE MAGHARA DISTRICT

Though cuesta-features are considered to be the main structural surface form, in the Maghara District, they are primarily initiated by stream erosion, and later modified by weathering and erosional processes operating under different climatic conditions in different stages. In fact scarp-forming rocks are related to the most resistant bands of the Bathonian and Callovian periods (i.e. The Flinty, Marly, and Chalky Limestones), yet they are initially excavated by the vertical corrosion of vales and streams flowing parallel to the strike of the rocks.

Field investigation of the composite cuesta's scarp slopes to the north of the Safa Camp, and one kilometre to the South-east of El-Melhi Camp indicates clearly the occurrence of successive stages of incision along the scarp slopes as a result of successive rejuvenation of vales cutting across alternating bands of resistant and less-resistant rocks.

Under the present arid climatic conditions of the Maghara District it is obvious that all these series of cuestas are in semi-or still stand conditions. In other words they may be considered as fossil features since the processes which initially produced them in the past are not working with the same rate at present.

The writer suggests that the area under consideration extensively modified during the pluvial stages of the Pleistocene (Zeuner, 1959). With regards to the close-texture of dissection, the deeply incised wadies, and the wide sheet of alluvial of deposits which comprise well rounded pebbles in the Maghara District, it is reasonable to conclude that the area suffered heavy rainfall during the pluvial stages of the Pleistocene. Through the initial stage, rainfalls excavate vales directed by the morphographic appearance of the pre-pluvial surface. But during the later stages streams follow the geological weakness of the rocks (i.e. fault-planes, strike direction, and less-resistant bands), while resistant bands give rise to the conspicuous scarps of the area. Consequently the drainage now appears to be adjusted to the underlying structure, though it is only formed by a partial cycle of erosion.

Field investigation reveals that cuestas in the Maghara District are being slightly modified under the present semi-arid climatic condition. The main processes responsible for the general trimming of geomorphographic appearance of the area are :

(*a*) The heavy cyclonic rainfalls which occur perhaps twice a year, causing tremendous torrents.

(*b*) Wind action.

(*c*) Alternate heating and cooling of the rock as a result of the large daily and seasonal range of temperature (about 15°-20°), which facilitates the disintegration and exfoliation of the rocks.

In the field it is observed that the long smooth dip-slopes of cuesta are in several parts dissected by vales which are mainly created during the occurrence of heavy rainfalls. A good example has been noticed at about one kilometre to the East of the Safa Camp (Pl. II, B), where the dip slope of a cuesta has been progressively lowered and dissected as

a result of the development of strike and dip type vales, cutting through the less-resistant rocks. Scarps are also exposed to intense exfoliation. The latter process has been noticed in action in the field, particularly where the scarp-forming rocks are heavly jointed and/or faulted. This process also facilitates the occurrence of rock-falls and subsequent backward extension of the scarps.

The composite scarp-slope of the Safa Camp, has also been extensively modified by gully erosion (Pl. I, A and III). Heavy cyclonic rainfalls always give rise to the development of anti-dip-type-gullies cutting the scarp slope and separated by small pyramid like-spurs. Subsequent erosion by these anti-dip-type-gullies are responsible for the process of scarp recession, which in turn brings about the destruction of dip-slopes at their upper end and leads to their extension at their lower end.

Since scarp-forming rocks in the Maghara District vary laterally in lithology and have been subjected to several morphogenetic processes operating under different types of climates (pluvial and arid conditions), and which were, in turn, more active in one place, on the scarp slope, than in others, it is believed that the scarp retreat in the area proceeded at unequal rates. Field investigation indicates that the process of exfoliation is more active at and near the scarp's crests. Consequently, we can safely say that the upper segments of the scarps moved faster than the lower ones, for the latter, have been the obvious zone for accumulation of debries and gully deposits creeping from above. This in turn partly explains the general characteristic of the scarp slopes, which are often found to comprise upper convexities and lower concavities.

BIBLIOGRAPHY

Abou El-Enin, H.S., « The geomorphology of the Moss Valley », Unpublished M.A. Thesis, Univ. of Sheffield, (1962).

—— « Some aspects of the drainage evolution... Northeast Derbyshire ». *The North. Univ. Geographical Jour.* 5 (1964), 45-54.

—— « An examination of the evolution of surface forms... », Unpublished Ph. D. Thesis, Univ. of Sheffield, (1964).

—— « Principles of geomorphology », Alexandria, (1966), [in Arabic].

ABOU EL-ENIN, H.S., « Glacial and associated features ... in southwest Yorkshire », *Bulletin of the Faculty of Arts,* Alex. Univ., (1965).

ARKELL, W.J., « Jurassic geology of the world », London (1956), 290-291.

AWAD, H., « La montagne du Sinaï Central », *Publ. Soc. Geograph.,* (1951), Cairo, 247 pp.

—— « Présentation d'une carte morphologique du Sinaï », *Bull. Inst. Désert, Egypte,* 2 (1), (1952), 132-138.

COAL-PROJECT, « The Coal Project Publications. The General Organisation for Industrialisation. Maghara Coal Field ».

COTTON, C.A., « Geomorphology », London (1952) 2nd edition.

DAVIS, W.M., « The drainage of cuestas », *Proc. Geol. Assoc.,* vol. 16 (1899-1900), 75-93.

—— « The geographical cycle », *Geog. Jour.* vol. XIV (1899), 481-504.

DE MARTONNE, M.E., « Abrégé de géographie physique », Paris (1922).

DERRUAU, M., « Précis de Géomorphologie », Paris (1956).

DOORNKAMP, J.C., « Observation on the development of cuestas ... », Unpublished M. Sc. Thesis, Univ. of Sheffield (1962).

FARAG, I.A.M., « Preliminary note on the geology of Risan Aneiza », *Bull. Fac. Sci.,* Cairo Univ. 26 (1947), 1-38.

GILBERT, G.K., « On the geology of the Henry Mts. », Washington (1877).

GRABAU, A.W., « The Niagara Cuesta ... », *Geogr. Jour.,* vol. 9 (1920), 264-276.

HILL, R.T., « Descriptive topographic terms of Spanish America », *Nat. Geog. Mag.,* vol. 7 (1896), 219-302.

HUTTON, A., « The theory of the Earth », Edinburgh, (1795).

LOBECK, A.K., « Geomorphology ... » New York, (1939).

MOON, F.W. and SADEK, H., « Topography and geology of Northern Sinai », *Petrol Research, Bull.* 10. Government Press, Cairo (1921), 154 pp.

PEEL, R.F., « Physical Geography », London, (1952).

POWELL, J.W., « Types of orographic structure ». *Amer. Jour. Sci.,* vol. 12 (1876), 441-428.

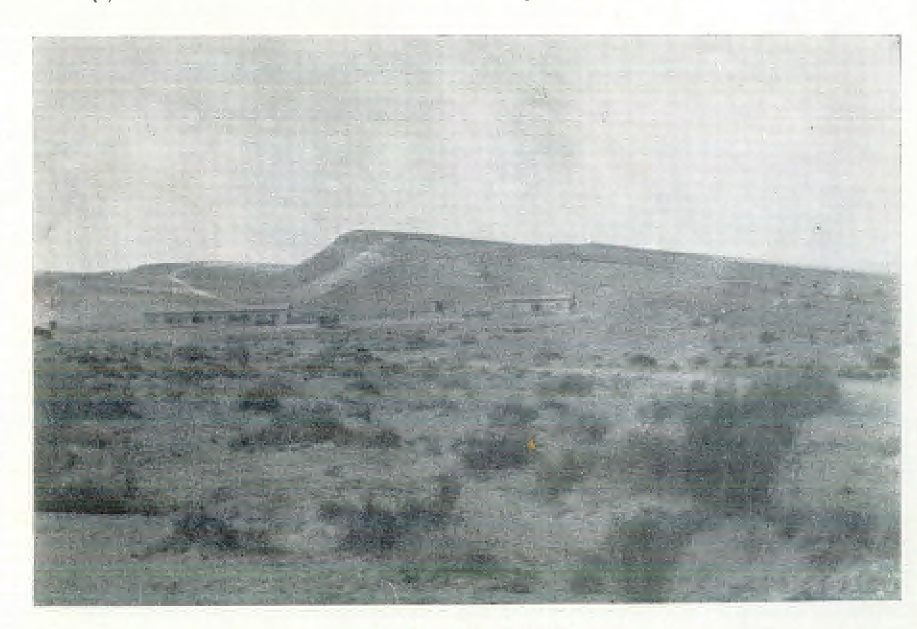
SAID, R., « The geology of Egypt », Elsevier, Amsterdam, (1962).

SCHMITTHENNER, H., « Die Regein der Morphologischen Gestating in Schichstufen », *Peter. Geog. Mitt.,* vol. 98 (1954), 3-10.

ZEUNER, F.E., « The Pleistocene Period », London, (1959).



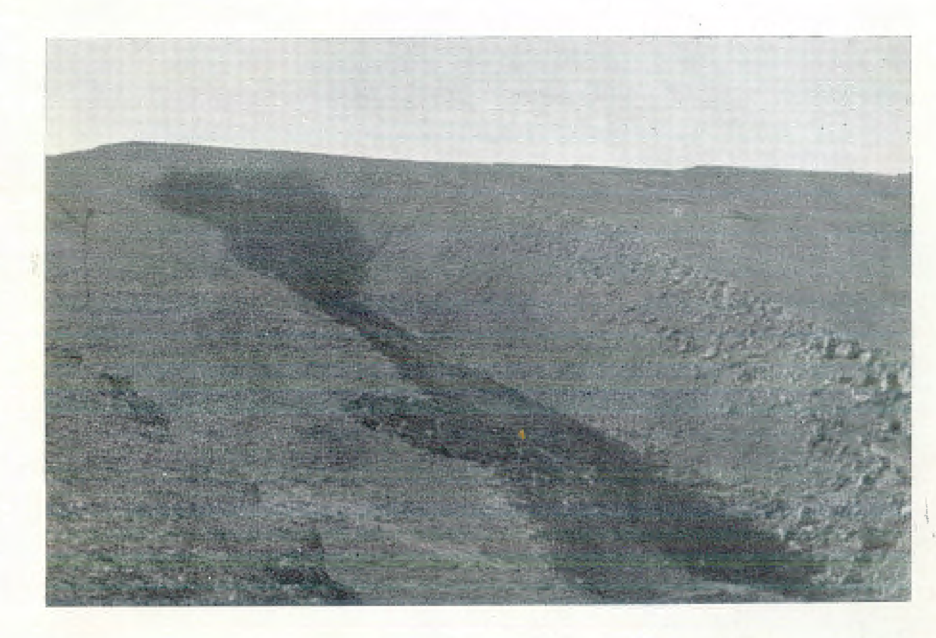
A. — A major cuesta on the primary watersheds of Wadi El-Safa.
(*a*) The composite scarp slope, and the gentle dip slope.
(*b*) The dissection of the cuesta's flank by bounding wadies and gullies.



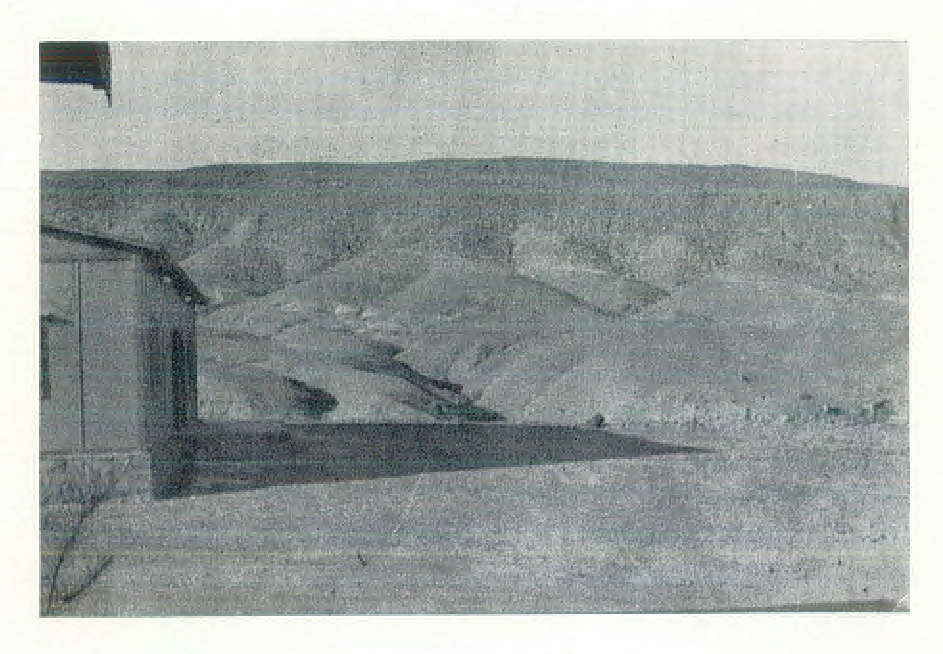
B. — An Intermediate cuesta within El-Melhi Valley, to the northwest of El-Melhi Camp.



A. — A series of a close spaced-intermediate cuestas within El-Melhi Valley.



B. — Dissection of the dip slopes of the Safa Camp Cuesta
by deeply incised dip type vale.



Headward recession of the Safa's scarp slope as a result of gully erosion.

BIBLIOTHÈQUE

OUVRAGES EN LANGUES EUROPÉENNES REÇUS EN 1966

I. — NATION ARABE, AFRIQUE.

ABDALLAH, A.M., EL-ADDINANI, A., and FAHMY, N. Stratigraphy of the Lower Mesozoic Rocks Western side of Gulf of Suez, Egypt. (Geolog. Survey and Mineral Research Dept., November 1963). Cairo 1965.

ABDALLAH, A.M. New Bathonian (Middle Jurassic) occurrence, at the Western side of the Gulf of Suez, Egypt. (Geolog. Survey and Mineral Research Dept., May 1964). Cairo 1965.

ABDUL AMIR Q. KUBBAH. Libya, its oil industry and economic system. (The Arab Petro-Economic Research Centre, Baghdad, Rihani Press). Beirut 1964.

ABDUL AZIZ KAMEL. Apartheid in South Africa. (United Nations Human Rights Seminar on Apartheid, 23 Aug.-5 Sept. 1966). Brazilia 1966.

ABDULJABBAR ARAIM. Nomadism and Sedentraisation in Iraq. (A study presented at Geneva Conference 1964, Al-Maaref Press). Baghdad 1966.

ABU HAKIMA AHMAD. History of Eastern Arabia, 1750-1800. The rise and development of Bahrain and Kuwait. (Khayats). Beirut 1965.

AL-BALADHURI, Abul Abbas Ahmad Ibn-Jabir. Kitab Futuh Al-Buldan. The origins of the Islamic State by Hitti. (Khayats). Beirut 1966.

AL-BAZZAZ. On Arab Nationalism. (Embassy of the Republic of Iraq, London). London 1965.

ALWAN, Mahamed. Algeria before the United Nations. (Robert Speller and Sons Publishers Inc.). New York 1959.

ANGUILE, A.G. and DAVID, J.E. L'Afrique sans frontières. (Editions Paul Bory-Monaco). Monaco 1965.

ASFOUR, Ed. Y. Saudi Arabia. Long-term Projections of supply of and demand for agricultural products. (Economic Research Inst., American University of Beirut). Beirut 1965.

AWAD, Galal and GHOBRIAL, Monir. Zonal stratigraphy of the Kharga Oasis. (Geolog. Survey Paper No. 34). Cairo 1966.

AWAD, Hassan. Zones Arides. (Extrait des Annales de Géographie, n° 408, mars-avril 1966).

BALANDIER, Georges. La vie quotidienne au Royaume de Kongo du XVIe au XVIIIe siècle. (Hachette). Paris 1965.

BALSAN, François. A pied au Nord Somali. (La Palatine). Paris 1965.

BERQUE, J., CHARNAY, J.-P. et autres. Normes et valeurs dans l'Islam contemporain. (Payot). Paris 1966.

BERLAN, Edouard. Addis-Ababa, la plus haute ville d'Afrique. Étude géographique. (Imprimerie Allier, Univ. de Grenoble, Faculté des Lettres et Sciences Humaines). Grenoble 1963.

BIRMINGHAM, W., NEUSTADT, I. and OMABOE, E.N. A study of Contemporary Ghana, vol. I. The Economy of Ghana. (George Allen and Unwin Ltd.). London 1966.

BLANCHARD, R. et DU BUIT, M. La Terre de la Promesse. Géographie de la Terre Sainte. (Coll. : Je sais, je crois, Librairie Arthène Fayard). Paris 1965.

BLANGUERNON, Claude. Le Hoggar. (B. Arthaud). Paris 1955.

BONN, Gisela. L'Afrique quitte la brousse. Traduit de l'allemand par Pierre Kammitzer. (Robert Laffont). Paris 1966.

CHRISTOPHE, Louis-A. Abou Simbel et l'épopée de sa découverte. (Éditions P.F. Merckx). Bruxelles 1965.

COQUERY, Catherine. La découverte de l'Afrique. (Collection Archives, Juillard). Paris 1965.

CROWDER, Michael. The story of Nigeria. (Faber and Faber). London 1966.

DABBAGH, Hashim Al. Études statistiques sur le développement économique de l'Irak. (Chez l'Auteur, Adhamiyah Nassah). Baghdad 1960.

DAVIDSON, Basil. Which Way Africa? A search for a new society (Penguin African Library). Harmondsworth 1964.

—— Les voies africaines (Cahiers Libres 73-74, François Maspero). Paris 1965.

DOUMENGE, François, Géographie des Mers. («Magellan». La Géographie et ses problèmes, Presses Universitaires de France). Paris 1965.

DRESCH, J. et autres. Industrialisation au Maghreb. (François Maspero). Paris 1963.

DUBULA, Sol. La menace de l'apartheid. (Éditions Paix et Socialisme). Prague 1966.

DUWEINI, A. Khalaf El- and GHABBOUR, Samir. Population density and biomass of Earthworms in different types of Egyptian soils. (Extract of J. Appl. Ecol. No. 2, November 1965). Oxford 1965.

ESTIER, Claude. L'Egypte en révolution. (René Julliard). Paris 1965.

FOX, Frederic. 14 Africans vs. One American. (The MacMillan Company), New-York 1962.

GUIDES BLEUS, Les. Les grandes croisières en Méditerranée Orientale. (Librairie Hachette). Paris 1966.

GUITARD, Odette. Rhodésie et le Nyassaland (Rhodésie, Zambie et Malawi). (Coll. Que Sais-je? Presses Universitaires de France). Paris 1964.

HASSAN ABDALLAH. Handbook of Egypt. (National Publication and Printing House). Cairo 1966.

HASSAN HANAFY. Les méthodes de l'exégèse. Essai sur la science des fondements de la compréhension. (Cons. Supér. des Arts, des Lettres et des Sciences Sociales). Le Caire 1965.

HENDERSON, K.D.D. The making of the Modern Sudan. The life and letters of Sir Douglas Newbold. (Faber and Faber). London 1953.

HIRST, David. Oil and public opinion in the Middle East. (Faber and Faber). London 1966.

HITTI, Philip Khuri. The origins of the Islamic States. Kitab Futuh Al-Buldan. (Khayats). Beirut 1966.

HOLDEN, David. Farewell to Arabia. (Faber and Faber). London 1966.

HOLLINGWORTH, Clare. The Arabs and the West. (Methuen). London 1952.

ISNARD, Hildebert. Le Maghreb. (Presses Universitaires de France). Paris 1966.

JORDAN. First Census of Population and Housing, 18 November 1961, vol 2. Economic Characteristics of the Population. (Dept. of Statistics. The Hashemite Kingdom of Jordan, in English and Arabic), Amman, May 1964.

—— First Census of Population and Housing; vol. 3. Household and Housing Characteristics. (Dept. of Statistics). Amman 1964.

—— First Census of Population and Housing. Vol. 4. Methods Report. (Dept. of Statistics). Amman. 1965.

KRASHENINNIKOV, V.A. and PONIKAROV, V.P. Zonal Stratigraphy of Paleogene in the Nile Valley. (Geolog. Survey paper No. 22). Cairo 1965.

LAUNAY (Michel). Paysans algériens. La terre, la vigne et les pommes. (Éditions du Seuil). Paris 1963.

LE STRANGE, Guy. Palestine under the Moslems. A description of Syria and the Holy Land from A.D. 650-1500. (Khayats Oriental Reprints No. 14). Beirut 1965.

LEWIS, I.M. The modern history of Somaliland. (Weidenfeld and Nicolson). London 1965.

LOUIS, Wm. Roger. Ruanda-Urandi, 1884-1919. (Clarendon Press, Oxford University Press). Oxford 1963.

MACKINTOSH, John P.A., Nigerian government and politics. (George Allen and Unwin Ltd.). London 1966.

MAHMOUD ROUSAN. Palestine and the Internationalisation of Jerusalem. (The Ministry of Culture and Guidance). Baghdad 1965.

MAIR, L.P. An African people in the Twentieth Century. (Routledge and Kegan Paul. Ltd.). London 1965.

MARQUARD, L. The Story of South Africa. (New Edition). London 1965.

Meister, Albert. L'Afrique peut-elle partir? Changement social et développement en Afrique Orientale. (Éditions du Seuil), Paris 1966.

Middleton, J. and Campbell, J. Zanzibar; its society and its politics. (London Institute of Race Relations, Oxford University Press). London 1965.

Neumarx, S. Daniel. Foreign Trade and Economic development in Africa. A Historical Perspective. (Stanford University, California). Stanford 1964.

Oboli, H.O.N. An outline geography of West Africa. (George G. Harrap C° Ltd.). London 1965.

Partisans. L'Afrique dans l'épreuve. (Partisans. Revue éd. par François Maspero, n°s 29-30, mai-juin 1966). Paris 1966.

Pascal, Roger. La république Malgache. (Éditions Berger-Levrault). Paris 1965.

Peyrouton, Marcel. Histoire générale du Maghreb : Maroc, Algérie, Tunisie. Des origines à nos jours. (Éditions Albin Michel). Paris 1966.

Planhol, Xavier de. Nouveaux villages algérois; Atlas Blidéen, Chenoua, Mitidja occidentale. (Faculté des Lettres et Sciences Humaines d'Alger. Presses Universitaires de France). Paris 1961.

Prospective. L'Afrique en Devenir. (Prospective n° 13, Presses Universitaires de France). Paris 1966.

Ramly, Ismail Mahmoud El. The used of fissured limestone in locating ground water ressources and its application to Farafra Oasis. (Extr. from Trans. of the Arab Mining. Petrol. Assoc., vol. XIX, 1964). Cairo 1964.

Rousselle, Lucienne. Rhynchonellidae, Terebratulidae et Zeilleriidae du Dogger Marocain (Moyen-Atlas). (Travaux de l'Inst. Sc. Chérifien, Série Géologie et Géographie Physique n° 13). Rabat 1965.

Sabri Youssef and Samir El-Kahwagy. Geophysical and Geochemical Investigations at Umm Gheig Area. Eastern Desert. (General Egyptian Organisation for Geological Research and Mining, paper No. 33, 1963). Cairo 1966.

Schamp, Heinz. Der Nil und seine wasservirtschaftlischen probleme. (Sonderdruck aus Geographische Rundschau, No 12, Berlin 1959).

—— Mitteilungen vorläufiger Bericht ber eine Reise nach Agypten. (Sonderdruck aus Die Erde, Zeitschrift der Gesellschaft für Erdkunde zu Berlin, Heft 3, 1965).

—— Ägypten, Das Land am Nil im wirtschaflichen und sozialen Umbruch. (Verlag Moritz Diesterweg). Bonn 1966.

Seligman, G.C. and N.Z. Pagan Tribes of the Nilotic Sudan. (Routledge and Kegan Paul Ltd.). London 1965.

Shazly, E.M. El- and Abdallah, A.M. Geology of the sulphur occurrence of Ramga, Eastern Desert. (Geol. Survey paper No. 31). Cairo 1965.

Smith, T.E. and Blacker, J.G.C. Population characteristics of the Commonwealth Countries of Tropical Africa. (University of London, The Athlone Press) London 1963.

Sutter, Karl. Das Haus des Djerid. (Separatabdruck aus Geographica Helvetica, Nr. 1), Zürich 1964.

Sutter, Karl. Von Sitten und Brauchen im Mzab. (Separatabdruck aus Geographica Helvetica, Nr. 3). Zürich 1964.

Thomassery, Marguerite. Catalogue des périodiques d'Afrique Noire francophone (1858-1962) conservés à l'IFAN. (Inst. Français d'Afrique Noire, Université de Dakar, Catalogue et Document n° XIX). Dakar 1965.

Tillion, Germaine. Le Harem et les cousins. (Éditions du Seuil). Paris 1966.

Toupet, Charles. Étude du milieu physique du Massif de l'Assaba (Mauritanie). (Institut Fondamental d'Afrique Noire, Univ. de Dakar n° XX). Dakar 1966.

Trimingham, J. Spencer. Islam in East Africa. (Oxford University Press, Clarendon Press). Oxford 1965.

Turnbull, Colin. L'Africain désemparé, Traduction de «The Lonley African». (Éditions du Seuil). Paris 1965.

UNESCO. Land Use in Semi-Arid Mediterranean Climates. International Geographical Union Symposium, Iraklion 1962. (UNESCO, Arid Zone Research XXVI). U.N. 1964.

United Nations. Patterns of Social Welfare Organization and Administration in Africa. (Social Welfare Services in Africa No. 2, Economic Commission for Africa). New York 1964.

—— Training for Social Work in Africa. (Social Welfare Services in Africa No. 3, Economic Commission for Africa). New York 1964.

—— Investment Laws and Regulations in Africa. (United Nations Publications). New York 1965.

—— Bibliography of the Hydrology and Hydraulic development of the Nile Basin. (Economic Commission for Africa). Addis Ababa 1966.

Volkoff, O.V. L'Alexandrie du xviiie siècle décrite en russe par un moine grec. (Cahiers d'Alexandrie, 1966).

Wellard, James. The Great Sahara. (Hutchinson of London). London 1964.

Wolstenholme, G. and O'Connor, M. Man and Africa. (J. and A. Churchill, Ltd.). London 1965.

Young, R., Forsbrooke, Henry. Land and Politics among the Luguru of Tanganika. (Routledge and Kegan Paul Ltd.), London 1960.

Zaki Saleh. Britain and Mesopotamia (Iraq to 1914). A study in British Foreign Affairs. (Al-Maaref Press and University of Baghdad). Baghdad 1966.

Zayid Mahmud, Y. Egypt's Struggle for Independence. (Khayats). Beirut 1965.

II. — EUROPE, ASIE, AMÉRIQUE, OCÉANIE.

ALLEMAGNE. Leipziger Geographische Beiträge. (Deutschen Institut Fär Länderkunde Leipzig und dem Geographischen Institut der Karl-Marx-Universität). Leipzig 1965.

ANDERSEN, Hans. Beitrage zur Geomorphologie des Östlichen Hörnliberlandes. (Arbeitan aus dem Geographische Inst. der Univers. Zürich, Serie A. No. 137). Zurich 1965.

ARMENGAUD, André. La population française au XXe siècle. (Coll. Que sais-je? Presses Universitaires de France). Paris 1965.

BEALS, Carleton. L'Amérique Latine. Monde en révolution. (Payot). Paris 1966.

BEAUFRÉ, Général. L'O.T.A.N. et L'Europe. (Calmann-Lévy). Paris 1966.

BOESCH, Hans. La ville et l'urbanisation, sur la géographie de la ville suisse, la vue aérienne au cours des années. (Tiré à part du volume, Villes Suisses à vol d'oiseau par Kümmerly and Frey, Ed. Géogr., Berne).

—— Swei Jahre Wetterbeobachtungen in Nepal (1961-1963). (Separatabdruck aus « Geographica Helvetica » Nr. 3, 1964). Zürich 1965.

CHALINE, Cl., GEORGE, R. et ROGE, F. L'Europe des marchands. (Presses Universitaires de France). Paris 1964.

CHARLES, Raymond. Le Japon au rendez-vous de l'Occident. (Robert Laffont). Paris 1966.

DOCUMENTATION FRANÇAISE (LA). L'économie Yougoslave. Notes et Études Documentaires. Paris 5 mars 1965.

—— Le complexe économique du Bas-Danube. Paris 10 septembre 1965.

—— L'industrie française des pêches maritimes. Paris 14 septembre 1965.

—— Le commerce extérieur de la République Populaire de Chine. Paris 21 septembre 1965.

—— L'industrie automobile de l'U.R.S.S. et des démocraties populaires européennes. Paris 27 septembre 1965.

—— La population Britannique. Paris 30 septembre 1965.

—— L'agriculture en République Fédérale d'Allemagne. Paris 11 octobre 1965.

—— Le commerce extérieur des démocraties populaires européennes. Paris 14 décembre 1965.

—— Le developpement et la planification économique en Asie et en Extrême-Orient. Paris 27 décembre 1965.

—— L'industrie sidérurgique Italienne. Paris 5 janvier 1966.

—— La sidérurgie des Etats-Unis. Paris 11 janvier 1966.

DUBARBIER, Georges. La Chine moderne. (Collection : Que Sais-je? Presses Universitaires de France). Paris 1966.

DUMONT, René. La Chine surpeuplée. Tiers monde affamé. (Éditions du Seuil). Paris 1965.

DURANT-DASTÈS, François. Géographie de l'Inde. (Collection : Que Sais-je? Presses Universitaires de France). Paris 1965.

FORMOSA. China Yearbook 1965-1966. (Government Information Office). Taiwan 1966.

GEORGE, Pierre. L'économie de l'U.R.S.S. (Collection : Que Sais-je? Presses Universitaires de France). Paris 1965.

GUYAN, Walter Ulrich. Mittelalterliche Eisenhütten im Kanton Schaffhausen, Ergebnisse landschaftsgeschichtlicher Forschungen. (Sepratabdruch aus der Neuen Züricher Zeitung, Beilage « Technik », 23 sept. 1964) Zürich 1964.

HAEFNER, Harold. Vegetation und Wirtschaft der Oberen sudalpinen und Stude im Luftbild. (Arbeiten aus dem Geogr. Inst. der Universität Zürich, Serie A. Nr. 142). Zürich 1963.

—— Luftbild Valsorey-Gletscher (Kt. Wallis, Schweiz). (Sonderdruck aus « Die Erde », Heft 2, 1964). Berlin 1964.

HIERSEMENZEL, Sigrid-Elisabeth. Britische Agrarlandschaften im Rhythmus des Landwirtschaftlichen Arbeitsjahres. (Berliner Geographischen Inst. der Ferien Univ. Berlin).

INDIA, Recent advances in Zoology in India. Proceedings of the First Summer School of Zoology (Silma 1961) of the Govern. of India. (Ministry of Scientific Research and Cultural Affairs, Gov. of India Press). Delhi 1963.

JAPAN, Geology and mineral resources of Japan. (Geological Survey of Japan). Japan 1962.

—— Statistical Handbook of Japan 1965. (Bureau of Statistics, Office of the Prime Minister). Tokyo 1965.

JOHNSTON, Denis Foster. An analysis of sources of Information on the population of the Novaho. (Smithsonian Institution). Washington 1966.

JULIEN, Claude. Le Canada, dernière chance de l'Europe. (Bernard Grasset, Éditeur). Paris 1965.

KELLEY, Celsus. La Austrailia del Espiritu Saanto. (The Hakluyt Society at the Cambridge Univ. Press). Cambridge 1966.

LINDQVIST, Sven. China in Crisis. (Faber and Faber). London 1965.

MILLER, Harry. The story of Malaysia. (Faber and Faber). London 1965.

MILLS, Lennox A. Southeast Asia. Illusion and reality, politics and economics. (University of Minnesota Press). Minneapolis 1964.

MOUSKHELY, M. L'U.R.S.S. et les pays de l'Est. (Revue des Revues n° 3). Strasbourg 1963.

NIEDERGANG, Marcel. Les Vingt Amériques Latines. (Librairie Plon). Paris 1962.

O.C.D.E. Problèmes et politique de main-d'œuvre en Grèce. (Organisation de Coopération et de Développement Économiques). Paris 1965.

Penrose, C. Lands of Europe and Asia. (John Murray). London 1965.

Redmore, G.B. Under the Southern Cross. South America, Australia, Africa. (John Murray). London 1964.

Rovan, Joseph. L'Europe. (Éditions du Seuil). Paris 1966.

Shave, D.W. North Atlantic Neighbours. Britain, Canada, U.S.A. (John Murray). London 1958.

Steiner, Dieter. Technical Aspects of Air Photo Interpretation in the Soviet Union. (Reprinted from Photogrammetric Engineering, November 1963). Zürich 1963.

Suter, Karl. Der Zerfall des alpinen Nomadismus in Wallis und Tessin (Schweiz). (Sonderdruck auz Mitteilungen der Osterreichischen Geogr. Gesellschaft, Heft 1/11, Band 105, 1963). Wien 1963.

Van Vettere-Verhasselt, Yola. Les frontières du nord et de l'est de la Belgique. Étude de Géographie humaine. (Revue Belge de Géographie, vol. 89, 1965, 1-2-3). Bruxelles 1965.

Wohlgemuth, Hans Ulrich. Der Metallbergbau 1960 ; Ein Beitrag zum Problem der wirtschaftsgeographischen Karte. (Juris-Verlag Zürich). Zürich 1963.

III. — GÉNÉRALITÉS.

Archambault, M., Lhenaff, R. et Vanney, J. Documents et méthodes pour le commentaire de cartes. 1er fasc. : Principes généraux. (Masson et Cie). Paris 1965.

Berque, J. et Charnay, J.-P. De l'impérialisme à la décolonisation. (Les Éditions de Minuit). Paris 1965.

Biancheri, A. Les sociétés humaines. Exemples de leur organisation. (Librairie Larousse). Paris 1965.

Castro, Josué de. Géopolitique de la faim. Économie et humanisme. (Les Éditions Ouvrières). Paris 1965.

Charrier, Jean-Bernard. Citadins et ruraux. (Collection : Que Sais-je? Presses Universitaires de France). Paris 1964.

Cipolla, Carlo, M. The Economic History of World Population (A Pelican Original, Penguin Books Ltd.). Harmondsworth 1965.

Claval, Paul. Géographie générale des Marchés. (Cahiers de Géographie de Besançon). Paris 1962.

Cohen, Saul, B. Geography and politics in a divided world. (Methuen). London 1964.

Dickinson, Robert E. City and Region. A geographical interpretation. (Routledge and Kegan Paul Ltd.). London 1966.

Dingemans, Guy. Formation et transformation des races. Origine de l'espèce humaine. (Librairie Armand Colin). Paris 1956.

Dingemans, Guy. Formation et transformation des continents. (Librairie Armand Colin). Paris 1956.

—— Formation et transformation des espèces. (Librairie Armand Colin). Paris 1956.

Documentation Française (La). Le Cacao dans le monde. (Notes et Études Documentaires). Paris 25 octobre 1965.

F.A.O. Yearbook of Forest Products Statistics, 1965. (Food and Agriculture Organisation of the United Nations). Rome 1965.

Fox, A.F. The World of Oil. (The Commonwealth and International Library, Pergamon Press and the Macmillan C°). London 1964.

Freaser, Ronald. The Habitable Earth. (Hodder and Stoughton). London 1964.

George, Pierre. Géographie de la population. (Collection : Que sais-je? Presses Universitaires de France). Paris 1965.

—— Panorama du monde actuel. (Presses Universitaires de France). Paris 1965.

Ghaleb, Ed. Dictionnaire des Sciences de la Nature. Beyrouth.

Gornoung, M. Géographie économique du monde. (Éditions du Progrès). Moscou 1962.

Grimal, Henri. La décolonisation 1919-1963. (Armand Colin). Paris 1965.

Jansen, G.H. Afro-Asia and Non-Alignment. (Faber and Faber). London 1966.

Lacoste, Yves. Géographie du Sous-développement. (Presses Universitaires de France). Paris 1965.

Larras, Jean. L'aménagement des cours d'eau. (Collection : Que sais-je? Presses Universitaires de France). Paris 1965.

Lavau, Georges. La planification comme processus de décision. (Librairie Armand Colin). Paris 1965.

Lyttleton, R.A. How mountains are formed. (Smithsonian Institution, Publication No. 4621). Washington 1965.

Maire, L., Debré, R. et autres. La Faim. (Rencontres Internationales de Genève ; Éditions de la Baçonnière). Neuchatel 1960.

Moore, W.G. A Dictionary of Geography : definitions and explanations of terms used in Physical Geography. (Penguin Books Ltd.). Harmondsworth 1963.

Nkrumah, Kwame. Neo-Colonialism. The last stage of Imperialism. (The International Publishers). New York 1965.

Pérès, Jean-Marie. La découverte des Mers. (Collection : Que Sais-je? Presses Universitaires de France). Paris 1965.

Sherbatov, Gregory. Arabic Russian Dictionary. (Edited by Soviet Encyclopaedia). Moscow 1964.

United Nations. Processes and Problems of Industrialization in Under-Developed Countries. (United Nations Dept. of Economic and Social Affairs). New York 1955.

UNITED NATIONS. Industrial Standardization in Developing Countries. (United Nations). New York 1964.
—— La conjoncture économique. Études sur l'économie mondiale 1964, (2e partie). (Nations Unies). New York 1965.
—— Demographic Yearbook 1964. (Statistical Office, Dept. of Economic and Social Affairs). New York 1965.
—— Statistical Yearbook 1964. New York 1965.
—— World Economic Survey. Part I : Development Plans ; p. 2: Current Economic Developments. (U.N. Dept. of Economic and Social Affairs). New York 1965.
—— Planning for Economic Development. Vol. II : Studies of National Planning Experience, p. 1 : Private Enterprise and Mixed Economies. (U.N. Dept. of Econ. and Social Affairs). New York 1965.
—— Planning for Economic Development. Vol. II : Studies of National Planning Experience, p. 2 : Centrally Planned Economies. (U.N. Dept. of Econ. and Soc. Affairs). New York 1965.
VASSEUR, L.V. Pétrole et gaz naturel dans le monde. (Librairie Armand Colin). Paris 1965.

IV. — ATLAS.

GOUROU, Pierre. Nouvel Atlas du Monde. (Librairie Hachette). Paris 1965.
OXFORD. Oxford Regional Economic Atlas : Africa. (Oxford University Press at the Clarendon Press). Oxford 1965.
—— Oxford Economic Atlas of the World. (Oxford University Press at the Clarendon Press). Oxford 1962.
SERRYN, P., BLASSELLE, R., BONNET, M. Atlas Général Bordas. (Collection d'Atlas Géographiques et Historiques dirigée par Henri Bordas). 1957.

القاهرة

مطبعة المعهد العلمي الفرنسي للآثار الشرقية

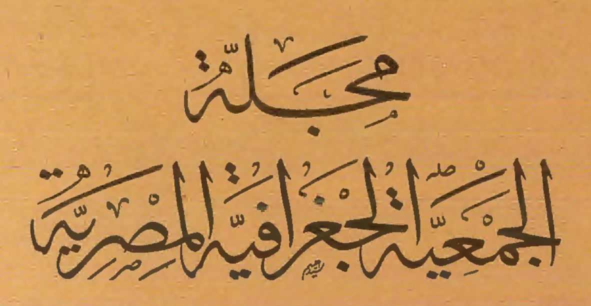
١٩٦٨

مجلة الجمعية الجغرافية المصرية

المجلد التاسع والثلاثون

١٩٦٦


مجلة
الجمعية الجغرافية المصرية



المجلد التاسع والثلاثون

١٩٦٦

BULLETIN DE LA SOCIÉTÉ DE GÉOGRAPHIE D'ÉGYPTE. — Tome XXXIX